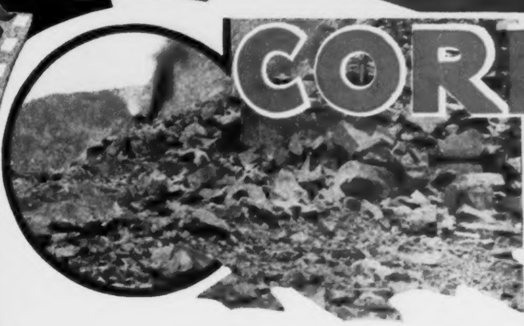
Rock Products

With which is Incorporated **CEMENT and ENGINEERING NEWS** Founded 1896

Chicago, July 5, 1930 Issued Every Other Week Volume XXXIII, No. 14



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NATHAN C. ROCKWOOD, *Editor and Manager*
EDMUND SHAW, Los Angeles, Calif., *Contributing Editor*
EARL C. HARSH *and*
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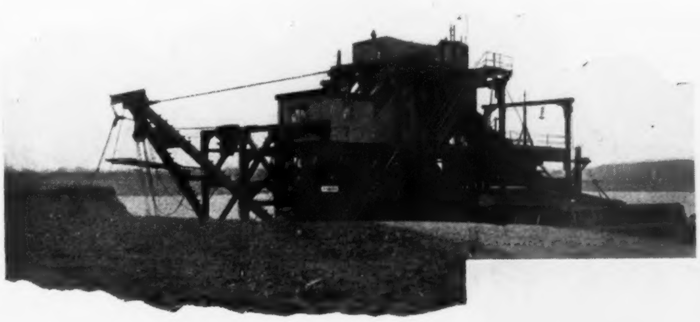
Volume XXXIII Chicago, July 5, 1930 Number 14

One of the World's Largest and Most Remarkable Gravel Plants

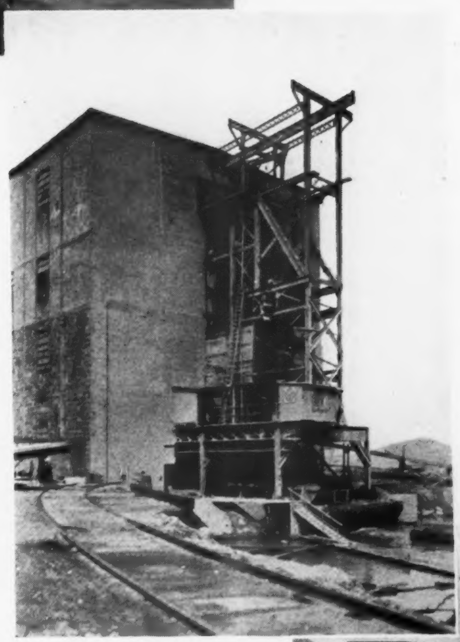
Van Sciver Operation of the Warner Company, Tullytown, Penn.



The digger dredge "Viking" at the Van Sciver plant of the Warner company

HUNDREDS OF THOUSANDS of passengers of the Pennsylvania railroad between New York and Philadelphia have noticed a clay-tile structure of unusual character on the east side of the tracks just below Trenton. Curiosity was often expressed regarding the nature of the operation, which was close to the railway tracks. For a long time their curiosity was not satisfied, but in 1929 the Van Sciver Corp. merged with the Charles Warner Co., under the name of the Warner Co. The merger represented assets of $20,000,000 and made the new company one of the largest producers of sand, gravel and lime products in the United States. And the very large and unusual gravel plant along the Pennsylvania railroad was properly labeled so that all who flash by in trains may read.

The daily output of sand and gravel from the plants involved in the merger is absorbed in the markets of Philadelphia, Camden, Trenton, Wilmington and their vicinities, a dense industrial section capable of absorbing a large tonnage of aggregates. That tonnage may run as high as 20,000 tons per day from the five Warner Co. plants, all located near Tullytown, Penn., on the Pennsylvania railroad seven miles south and west of Trenton, N. J. The consolidated companies here own over 6500 acres of excellent gravel-bearing ground.



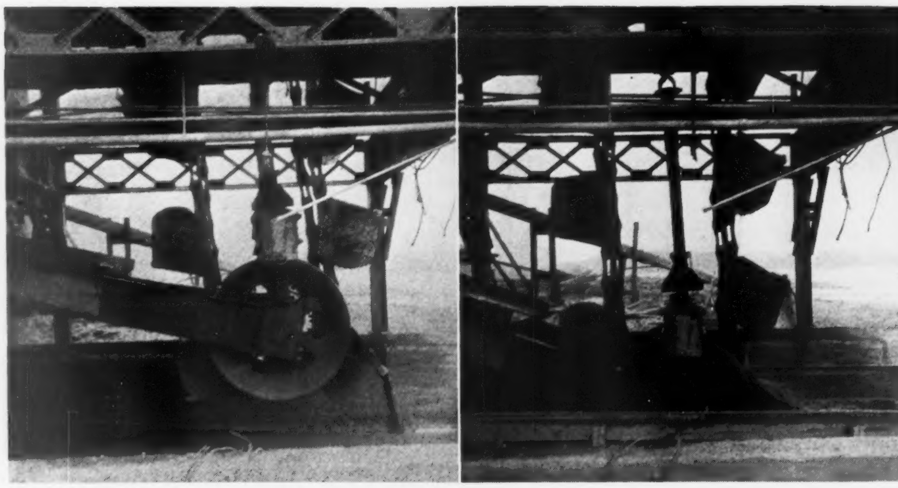
At right, view of the plant from the yard, and, above, elevator for unloading the barges

Sand and gravel from these plants is shipped by barge on the Delaware river to distribution yards located at strategic points on water fronts from Trenton south to Wilmington. Rail and truck deliveries are also made. At Philadelphia alone the company has five of these river-front yards which permit prompt shipments to all city points. Another large yard is maintained at Wilmington. For river transportation the company maintains a fleet of 130 barges and in Philadelphia over 200 trucks are kept in service for city deliveries.

Nine years ago, that is in March, 1921, the old West Jersey Sand and Supply Corp., of which the Warner Co. is the present successor, branched out into the ready-mixed concrete business, first erecting a single plant. Today the Warner Co. has five ready-mixed concrete plants in Philadelphia, and its agitating trucks on the streets in that city have ceased to be a novelty to the average citizen.

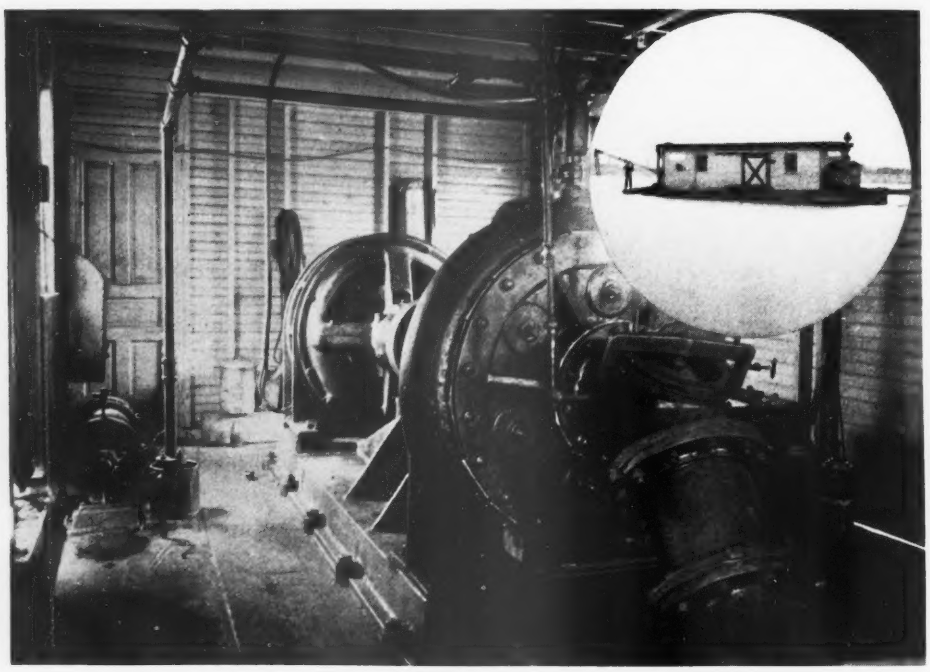
Van Sciver Plant

One of the plants involved in this merger was the Tullytown operation of the former Van Sciver Corp. This one plant has produced close to 10,000 tons in an 11-hour day. Although built eight years ago, the plant still retains its identity as the Van Sciver plant and was, at the time of its construction, considered a radical departure from common practice in the sand and gravel industry. This plant has never been described in print and has been seen by few visitors. And its principal features are just as novel and interesting as they were when it was built. This plant is the largest sand and gravel single operation of the Warner Co. and in this respect has considerably exceeded expectations.



Boot of the bucket elevator which unloads the barges, in raised and in operating position

Practically all of the shipments for the past year from this plant have been by rail, although the company owns a six-mile, standard-gage spur that connects the plant with the navigable Delaware river, and if desired the aggregates can be shipped by water. However, other plants of the Warner Co. are more conveniently located for straight water shipments.

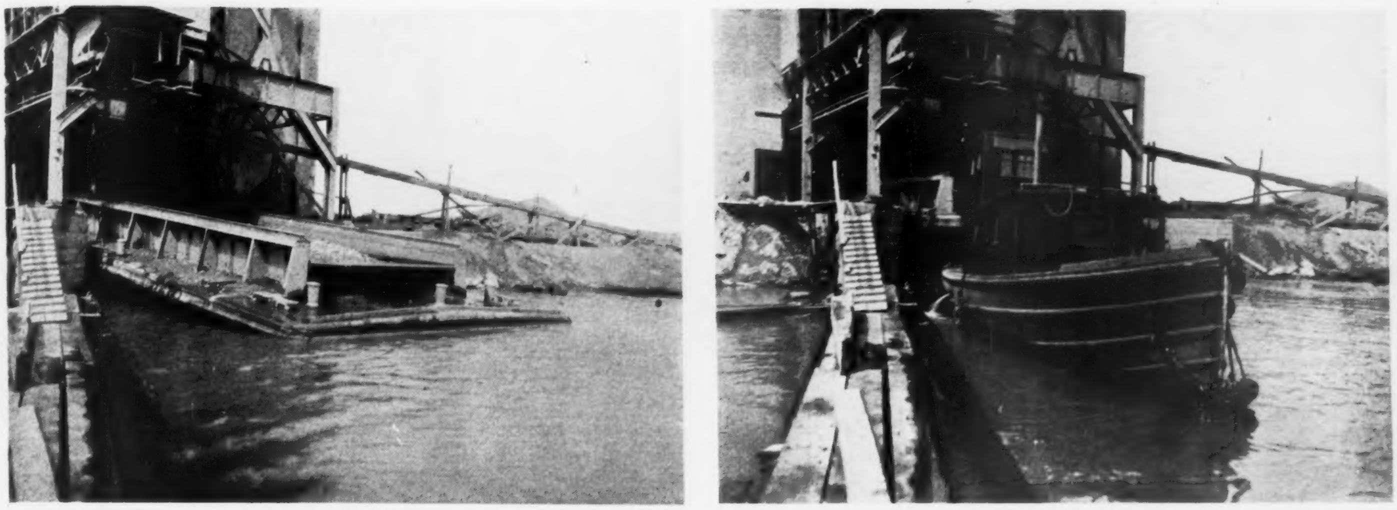


Drive motor and 10-in. pump on the dredge "Midget," which supplies additional bar sand when needed. Inset shows the "Midget"

With the river-connecting railroad and for stockpiling, plant switching, etc., there are available at the Van Sciver plant, 48 all-steel, hopper-bottomed, standard-gage cars and three 60-ton Baldwin and one 50-ton Porter steam locomotives. The company has here between 5 and 10 miles of standard-gage railroad tracks, all on its own property.

The deposits at Tullytown are old river-bed deposits, piled perhaps by glaciers, and at the Van Sciver operation the gravel is dug by a digger dredge. The use of a suction dredge is not feasible on account of the large boulders frequently encountered. No stripping is necessary. The material in the bank is a fairly clean gravel, 85% of which is plus ¼-in., and 30% of the total is of such large size that it has to be crushed. The de-

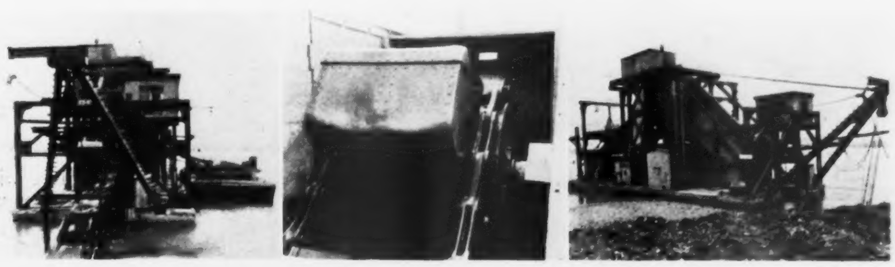
The installing of the grizzly at left accounted for considerable increase in tonnage. The dredged material flows through the inclined launder to the barge at right



The barge unloading elevator with a barge in position and one of the Diesel-driven tow boats which bring the barges from the dredges and backs them into the slip

posit varies in depth from 28 to 38 ft., with a bank above water of from 8 to 18 ft. The dredge *Viking* that is now in service can dig to a depth of 37 ft. below water level.

This dredge was designed by the engineers of the Van Sciver Corp. with most of the equipment supplied by the Link-Belt Co., and has hull dimensions of 100 ft. by 36 ft., with a draft forward of 8 ft. 6 in. and a draft aft of 5 ft. 6 in. The digger ladder has 34 two-compartment buckets, each holding 1¼-yd., and is driven by a 150-hp. Westinghouse motor through 36-in. belt and a gear train. The buckets are provided with manganese-steel replaceable lips and under the digging conditions encountered last on an average of one year.

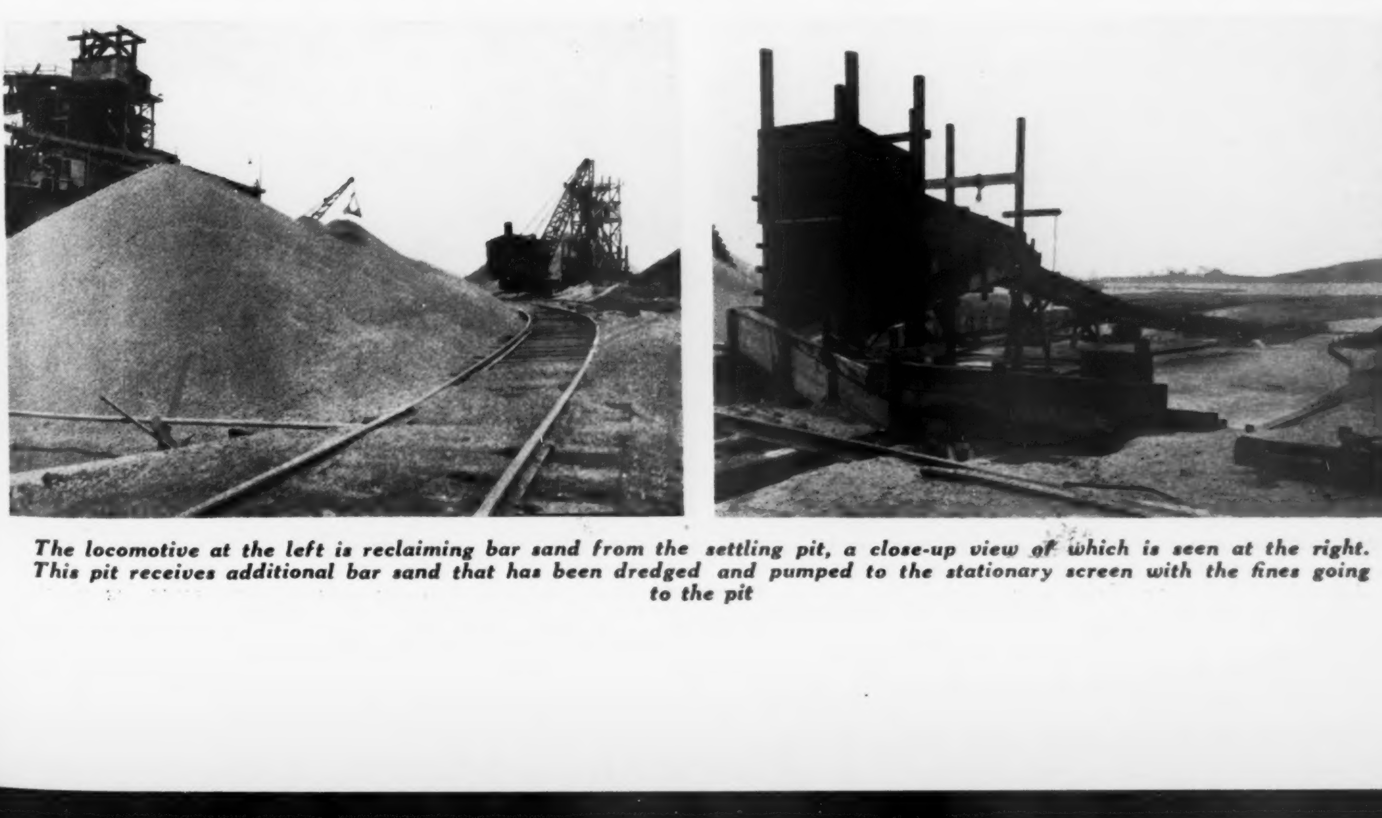


Some views of the digger dredge "Viking." Left, the digging ladder raised; center, head pulley and buckets, and, right, looking at the starboard side

Up to the time the Warner Co. took over the dredge the bucket line discharged to a closed scrubber and then to the barges, and when a large boulder got into one of the buckets it was necessary to remove this stone by hand before proceeding. This was not often, but minutes are precious when a dredge is called upon to produce in the neighborhood of 1000 tons per hour. To correct this condition the engineers of the Warner Co. removed the scrubber and installed steel chutes and a 12-in. bar grizzly, so that the main bucket line now discharges over this grizzly, with the troublesome boulders being chuted back to the dredge pond and the minus 12-in. sluiced to the barges that serve the plant. A 10-in. Worthington centrifugal pump, direct-connected to a 50-hp. Westinghouse motor, supplies the water for sluicing the gravel and sand to the barges. The water draining from the dredge carries most of the silt back to the pond also; this gives the material a rough but preliminary washing.

Two Lambert hoists, direct-connected, one to a 50-hp. and the other to a 35-hp. motor, operate the digging ladder and shore lines, with controls centralized in a conveniently located cabin.

There are four armor-plated spuds with wooden cores and a 6-ft. solid steel point,



The locomotive at the left is reclaiming bar sand from the settling pit, a close-up view of which is seen at the right. This pit receives additional bar sand that has been dredged and pumped to the stationary screen with the fines going to the pit

The dredge receives its electrical current through this cable and the reserve is carried on the reel

which are raised and lowered by a separate hoist. Also, the barges, on arrival at the dredge, are controlled by still another hoist.

Current is delivered to the dredge at 2300 volts from transformers located on shore through a special submarine cable. This cable has its outer layers protected by a woven wire cover, using a wire of small diameter. The cable is 1400 ft. long. Any excess cable is carried on the deck of the dredge on a convenient reel. This cable has been in use for six years and has given excellent satisfaction, and prior to its installation considerable trouble was experienced in getting a cable that would stand up under the severe service. The cable was supplied by John A. Roebling and Sons Co.

(Other operators using reels or keeping their power cables coiled have reported increases in their power bills from such a procedure, but apparently this only happens where a poorly insulated cable is used, for no power increase has been noted in this instance.—Editor.)

The digger dredge discharges to barges which are towed to the plant, about 3000 ft. away, by two Diesel-powered tug boats. There are four barges with wooden hulls and one of steel, each of which is 72 ft. by 22 ft., and when loaded draws 6 ft. of water. The barges each hold 230 tons of recoverable material, and this amount can be loaded in from 12 to 15 minutes by the dredge.

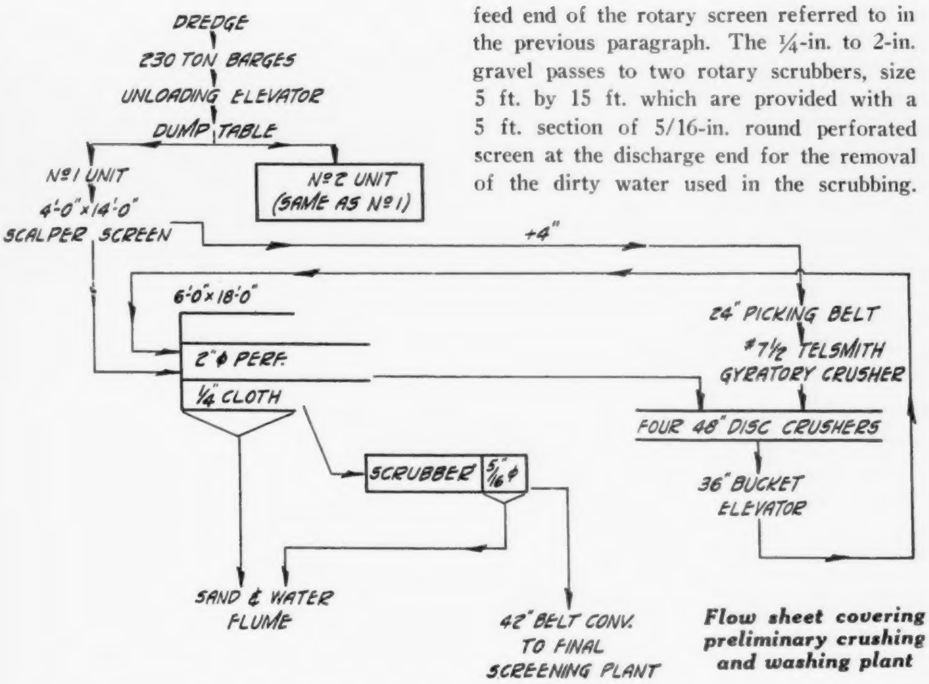
The barges on arriving at the plant are backed into a slip that is slightly wider than the barges, and after being properly placed in the slip, a bucket elevator is lowered, which virtually redigs the sand and gravel. This bucket elevator acts exactly on the same principle as the digging bucket line on the dredge. The whole bucket line can be raised and lowered to permit the barges to enter the slip and to reclaim the material in question. Unloading of the barge is started at the forward end and as the unloading proceeds, the boat is pulled slowly forward by a single-drum hoist.

There are 36 manganese-steel, two-compartment buckets on this line, each holding 1¼ yd. of material. The elevator has a lift of 70 ft. The designing of the buckets, chain and drive mechanism was done by the company. The major parts of this elevator are interchangeable with the digging line of the dredge *Viking*. The elevator is driven by a 200-hp. Westinghouse motor through a silent-chain drive and open herringbone gears.

Device for loading larger sizes of gravel so as to reduce segregation to the minimum

The buckets discharge to a "dividing table" resembling an inverted "V," one half of the product going through one set of

General view of the Warner Co. Van Sciver plant. Large building in foreground is the crushing and screening plant



Flow sheet covering preliminary crushing and washing plant

rotary screens and the other half going to a second set of Stephens-Adamson screens. In some respects the crushing and preliminary screening plant can be said to be in two units that can be operated separately or in conjunction with each other.

Once the material is taken from the barges, the primary object of this preliminary treatment is to (1) separate the sand, (2) crush the oversize to minus 2-in., (3) scour and thoroughly wash the gravel and crushed gravel, (4) recombine all but the sand, and (5) convey this recombined aggregate to a separate unit and rescreen to bins. With this in mind, it will be simple for the reader to follow the flow of material through the plant.

The material from the dividing plate falls to a 4-ft. by 14-ft. rotary scalper having 4-in. square openings. This scalping screen is made up of a web of manganese-steel bars, ⅝ in. by 1¾ in., and riveted at the joints. The design is very rugged to withstand the tremendous tonnage of large gravel that the scalpers are called upon to handle. The two scalpers are each driven by 20-hp. motors. The oversize from the scalpers is chuted to a 36-in. sorting belt where any stray bits of wood, roots or clay balls are removed, and the gravel is then discharged to a No. 7½ Telsmith gyratory crusher. This crusher can take a 16-in. stone. The discharge from the Telsmith passes to the Symons disc crushers and then to a bucket elevator and is returned to the system.

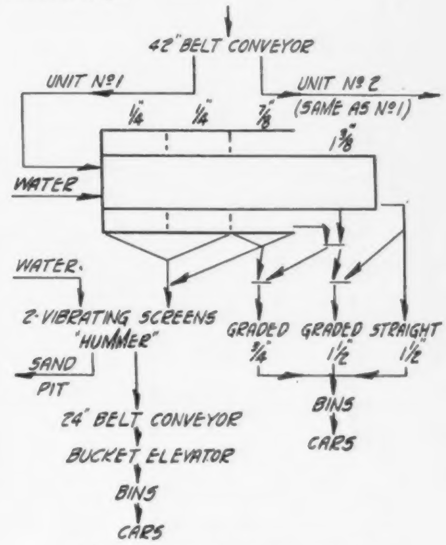
The minus 4-in. material falls to 6-ft. by 18-ft. Stephens-Adamson rotary screens having 16-ft. outer jackets of ¼-in. meshed wire cloth. The main barrel of these screens are all 2-in. round perforations.

The oversize from this screen is chuted to two of four 48-in. Symons disc crushers set to discharge a 1-in. product, which is received by the same bucket elevator serving the gyratory crusher and returned to the feed end of the rotary screen referred to in the previous paragraph. The ¼-in. to 2-in. gravel passes to two rotary scrubbers, size 5 ft. by 15 ft. which are provided with a 5 ft. section of 5/16-in. round perforated screen at the discharge end for the removal of the dirty water used in the scrubbing.

The clean gravel is then chuted to a 42-in. inclined belt conveyor and elevated and conveyed to the screening plant. The screens carry a heavy load of material, but by this double screening and by supplying a large amount of water to each screen, including the scalpers, a clean product is assured.

To wash such large tonnages, water in unusual volume is required, which is supplied by a battery of six 8-in. Worthington centrifugal pumps, each pump direct-connected to a 75-hp. motor. A seventh, 8-in. pump and motor is being installed, as the demand for cleaner products calls for an even greater use of water. These motors, as well as all the balance of the motors in the plant, unless otherwise specified, are Westinghouse and operate on purchased power at 440 volts, 3-phase and 60-cycle. The pumps are located on the ground floor of the crushing plant and have their suction lines near the barge slips.

The Symons disc crushers are arranged in two rows, each row of two crushers being driven from a 100-hp. induction motor by belts from separate line shafts; one of these line shafts, however, also carries the load of the gyratory crusher. The line shafts are powered through Texrope drives with one of the drives having the direction of pull vertical. This is a very unusual method of mounting a drive but appears to be quite satisfactory.

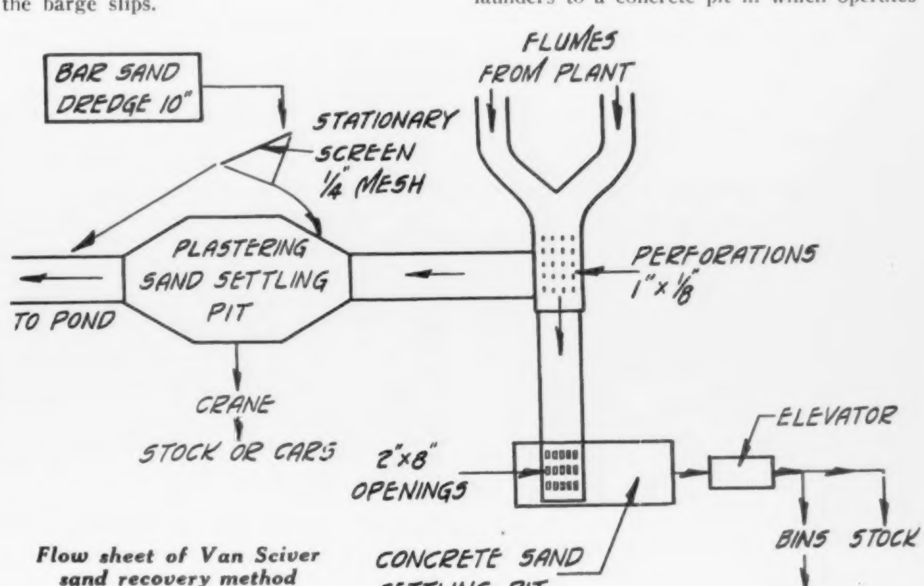


Flow sheet of final screening arrangement

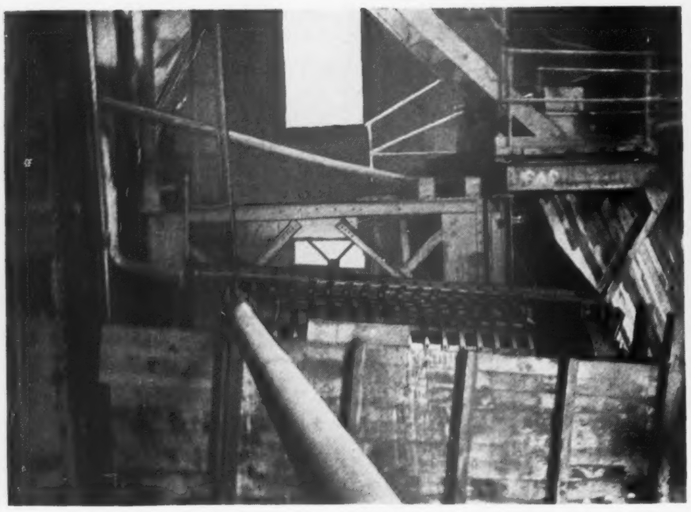
The upper and lower washing screens are each driven by a 25-hp. induction motor through open and silent-chain drives.

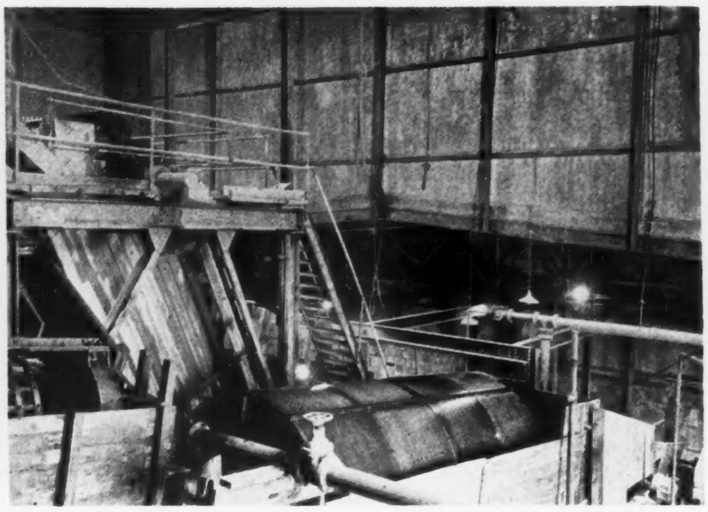
The building housing this equipment is of steel and clay hollow tile construction and has a concrete floor. All stairs and runways are of steel with proper safeguards, hand rails, etc. The screening equipment is all arranged in a single large and well lighted room so that a small crew can look after the operation.

The sand (minus ¼-in.) from the four rotary screens and scrubbers flows to two, 20-in. by 20-in., flat-bottomed, rectangular launders to a concrete pit in which operates



Flow sheet of Van Sciver sand recovery method





The rotary scalper screen is of heavy construction to withstand the pounding of 10,000 tons of gravel each day. At right, the end of the rotary scalper and the secondary washing screen

a third bucket elevator of the type used for the unloading of the barges. The discharge ends of the flumes converge and then widen out to appromixately 8 ft. width. At this point there is a perforated launder plate having slotted openings 1-in. by ⅛-in. arranged with a long axis parallel to the direction of the stream's flow. Part of the finer sand and water passes through these slots and is then delivered to a large settling pit. The sand that settles in this pit is the plastering or building sand. It is removed by an Ohio steam locomotive crane using a Hayward bucket of 1¾-yd. capacity.

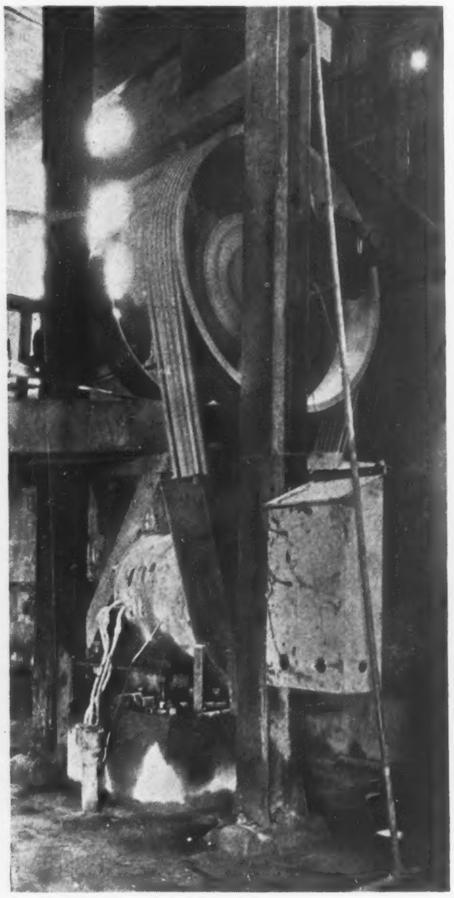
The overflow from this settling pit passes back to the dredge pond.

The nature of the raw material is such that the concrete sand (minus ¼-in.) carries too large a percentage of fine sand (minus ⅛-in.). By the removal of a proportion of the fine sand through the above mentioned perforated plates, a proper grading of the concrete sand is obtained.

Very often there is a deficiency of this fine sand (bar sand), so a second dredge is maintained to make up this shortage. This is a suction dredge and uses a 10-in. Morris stand pump, direct-connected to a 200-hp., 2200-volt induction motor by which the sand that has settled in the dredge pond from prior operations is repumped to the head end of the bar sand settling arrangement.

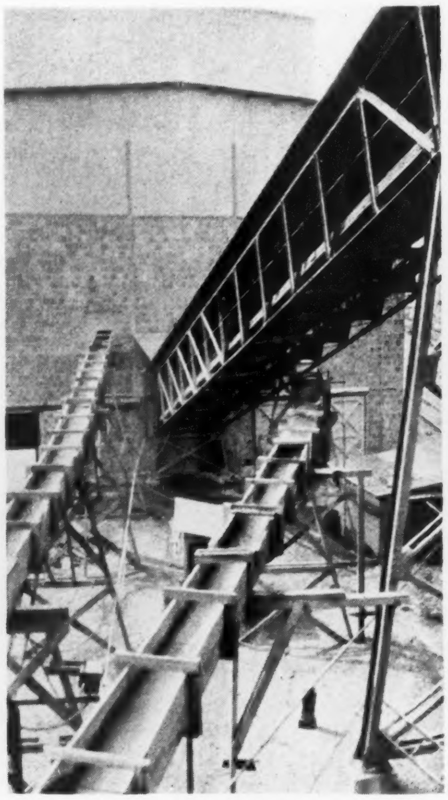
The dredge pump is mounted on a 20-ft. by 50-ft. wooden hull and uses an open, funneled suction with the enlarged end outward. A 10-in. discharge line serves the plant, a distance of roughly 1000 ft. A 2-in. centrifugal pump, direct-connected to a 10-hp. General Electric motor, supplies priming water. The dredge anchor and suction lines are controlled from a two-drum Clyde hoist, direct-connected to a 15-hp. General Electric motor. The submarine cable for supplying power to this dredge follows the discharge line, taking off from transformers near the plant.

The concrete sand (minus ¼-in. plus a proper percentage of the fines) that is retained on the slotted launder plate then



An unusual vertical drive for two 48-in. crushers

The turbulence is caused by the water and sands passing over slots that remove the concrete sands



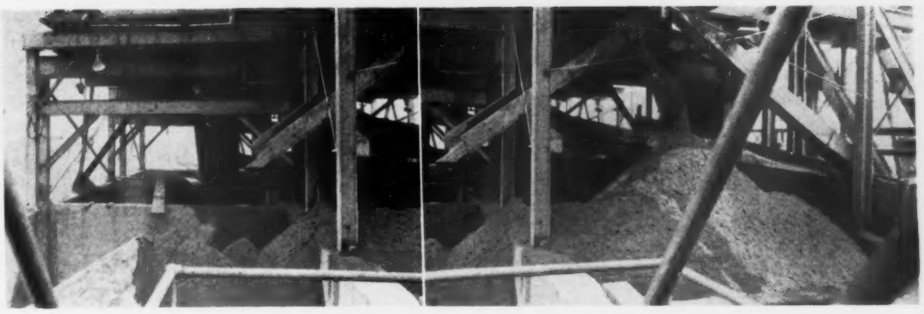
The launders in the foreground join and carry the 1/4-in. material to the sand plant

passes to a large concrete dewatering pit from which it is elevated by a large capacity elevator of similar design to the one used for unloading the barges. The buckets each hold 1 yd. and are provided with two small screens in the back for dewatering. This bucket line has a center-to-center lift of 70 ft. and is driven by a 100-hp. motor.

The sand elevator discharges to bins or to outside storage, where the material is reclaimed by steam cranes.

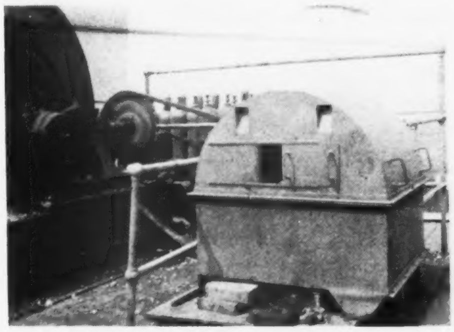
Returning to the crushing and preliminary washing plant, it will be recalled that the recombined aggregates all discharge to a 42-in. inclined belt conveyor. This conveyor serves the two 6-ft. by 25-ft. Allis-Chalmers rotary screens. The layout of the perforations in these screens is such as to give a graded product suitable for the market demands in that territory, and the quadrants in each screen section may, in some instances, have holes of different diameter.

In general, however, these two sizing screens over the bins divide the gravel into three sizes., viz.: pea gravel (minus ⅝-in.), ¾-in. gravel (minus 1⅜-in.), 1½-in. gravel (minus 2-in.). One pair of the elevated bins is devoted to the ¾-in. gravel, another pair to the graded 1½-in., which contains the proper percentage of ¾-in. gravel, and the third pair is filled with the 1½-in. straight gravel. Suitable hoppers and gates under these screens admit of the deflection of the different materials to the proper bins in the correct proportions required by the various specifications. The screens are driven by 25-hp. motors through Falk speed reducers in conjunction with roller chains, with the motors protected from the weather by small all-metal housings. The gravel is again washed in these screens from a 6-in. pipe that passes



The washed gravel is chuted to bins of structural steel and concrete

through the center axis of each screen. The ¾-in. and 1½-in. sizes fall to concrete bins below, while the pea gravel is flumed to two Hum-mer screens mounted one above the other, where these sizes receive a final washing. The product then passes to a short, 24-



The finishing screen motors are protected from the weather by neat, all-metal huts

in. belt conveyor and bucket elevator to steel bins, or is flumed to ground storage.

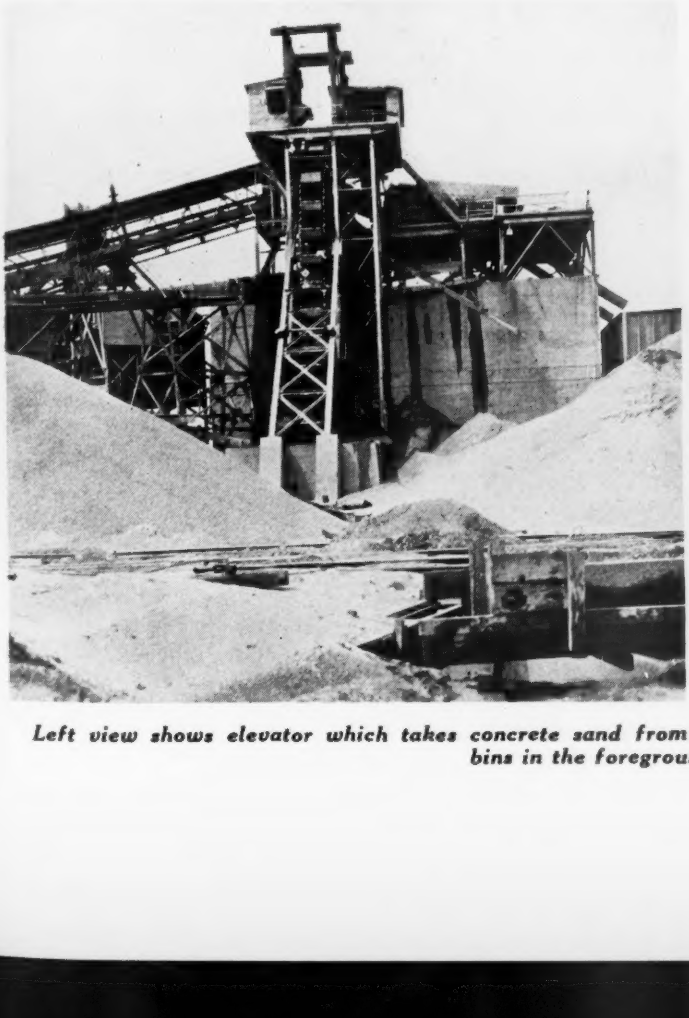
There are six concrete bins and four steel bins, each holding 300 tons. The bins discharge to cars for shipment or transfer to the marine terminal by the company's own cars.

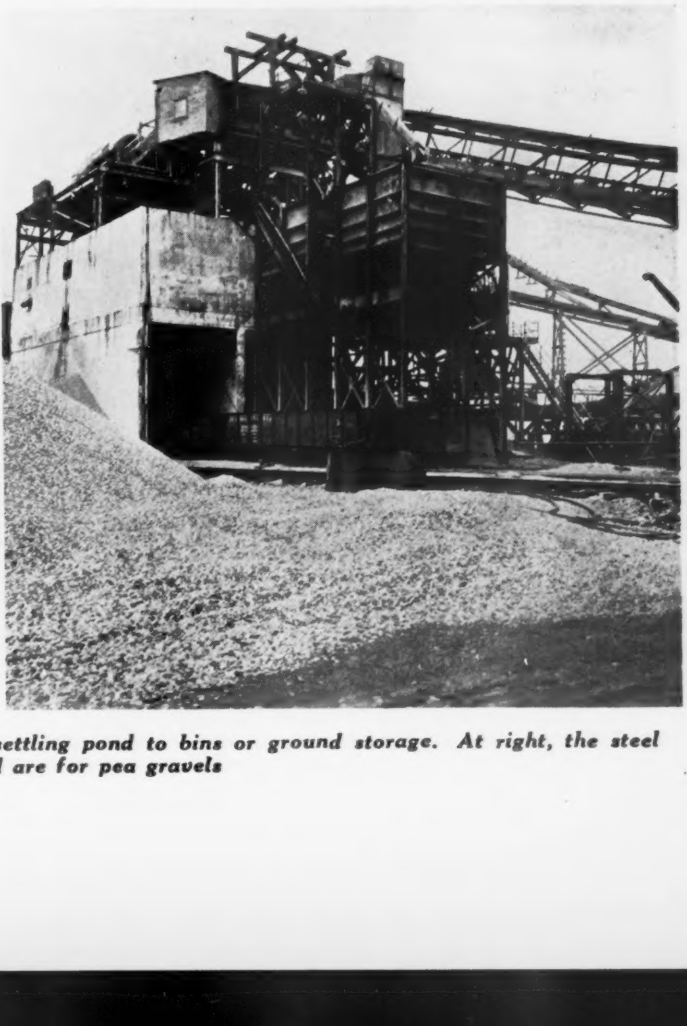
The company has large ground storage facilities, the material being unloaded to these piles from the gondolas by either a 1¾-yd. Link-Belt steam railroad crane, a 1½-yd. McMyler-Interstate, or two 1¾-yd. Ohio shovels. The Link-Belt crane has a 65-ft. boom; the Ohio's, 50 and 60 ft., respectively, and the McMyler a 50-ft. Both Williams and Hayward buckets are used.

The subject of segregation while loading gondolas has received attention and as a result the 1½-in. sizes are chuted to the gongolas by a specially designed chute that is hinged at the top and is swung back and forth by a train of gears and levers operated by a small electric motor during loading. The material is again washed and sceened as it is being loaded by passing it over a small stationary ¼-in. meshed screen on which water is sprayed. The fines are chuted to a sump.

Personnel

The executive offices of the Warner Co. are at 1518 Walnut street, Union Bank Bldg.,





Left view shows elevator which takes concrete sand from settling pond to bins or ground storage. At right, the steel bins in the foreground are for pea gravels

Philadelphia. Charles Warner is president; Alexander Foster, vice-president in charge of all sand and gravel operations, and Irving Warner is vice-president and chief engineer; Frank K. Wills is general superintendent, in charge of all sand and gravel plants in the Tullytown district.

Calvin Lunderman is superintendent of the Van Sciver plant; Paul Elliott, assistant superintendent; Ed Moore, master mechanic; Harry Parr, crusher plant foreman; H. Updyke, dredge captain; James Wilson, crane foreman; Tony Angelo, track foreman, and John Yount and Dan Larson in the office.

Conglomerate for Road Foundation

How an Accident Developed a Valuable Material

By James N. Hatch
Pasadena, Calif.

IT HAS OFTEN been remarked how many great discoveries were made accidentally. Or perhaps incidentally might be a better word in many cases, where in developing one article, another perhaps much more valuable has been unexpectedly brought to light. Such was the case in the development of the conglomerate quarry in Sycamore Canyon, near Whittier, Calif., now producing over 1000 tons per day.

The Sycamore Sand and Gravel Co., now a part of the Consolidated Rock Products Co., was in 1917 operating a sand and gravel screening and washing plant at the mouth of Sycamore Canyon, when there was discovered an immense ledge of conglomerate farther up the canyon. Another plant was built near this ledge to use this material for the production of gravel. This conglomerate is made up of water-worn gravel cemented together with a clayey binder. The material was blasted from the ledge, using coyote blasting methods, loaded by steam shovel and put through the washing plant where the binder was washed out, giving a good grade of gravel.

After about three years of operation as a washed gravel plant it was discovered that the conglomerate material had high value as a substitute for decomposed granite and could be sold at as high a price direct from the bank, without processing, as it could be after being screened and washed. The material, crushed and screened down to a size of about 1¼ in. in diameter, when placed as a foundation for a road or street, packs very hard and makes an excellent foundation. Distribution is by truck and the material finds a market over a large area in the San Gabriel Valley.

It might be remarked that when this "quarry" was opened up it was operated by men with teams and the material was hauled to its destination in stick-wagons and dump-wagons. With such facilities it was not practicable to attempt to deliver material more than 10 or 12 miles, unless it was hauled to Whittier and loaded on cars, which was rarely the case. This plant was the first of the company's to be operated by electric power, the older plant at the mouth of the canyon having been operated by a gas engine. The company purchased its first motor truck in 1918.

Largest Shot on Record

THE LARGEST QUARRY BLAST on record was 182 tons of dynamite exploded at the Blue Diamond Materials Co. quarry at Corona, Calif., on April 27, 1924.

Drilling and Blasting in Metal-Mine Drifts and Crosscuts

IN CO-OPERATION with western mining companies, the Bureau of Mines has conducted an investigation to ascertain the safest and most economical explosive for use in metal mines and to determine the best methods of blasting under various conditions. One investigation carried out a study of the drilling and blasting of drift rounds and brings a comprehensive observation of the current blasting practices at western metal mines. Numerous blasting tests were made in which consideration was given to the mechanics of drift rounds, to the use of different kinds, amounts and grades of explosives, and to the effect produced on blasting rounds by the structure and physical characteristics of the rock. The purpose of this investigation was to find the best form of round, the most economical explosive to use, and the proper method of blasting under given conditions.

A report showing the results obtained and conclusions drawn from observing the blasting of 108 rounds at 13 mines in six different states has been published by the Bureau of Mines, written by E. D. Gardner, and designated as Bulletin No. 311. The pamphlet of 170 pages is amply illustrated. It can be secured from the Superintendent of Documents at Washington, for 40 cents.

Phosphate Rock Data

CIRCULAR No. 6256, published by the Department of Commerce, Bureau of Mines, gives information relative to phosphate rock. The paper, written by Bertrand L. Johnson, associate scientist, rare metals and nonmetallic division of the bureau, gives a discussion of the origin, occurrence of phosphate rock and descriptions of deposits in the United States. Statistical data relative to the industry are appended.

Left, the quarry face and working floor cleared in preparation for a shot. Right, the tunnel or coyote in the conglomerate formation near Whittier, Calif.

One Man's Development of Limestone Products

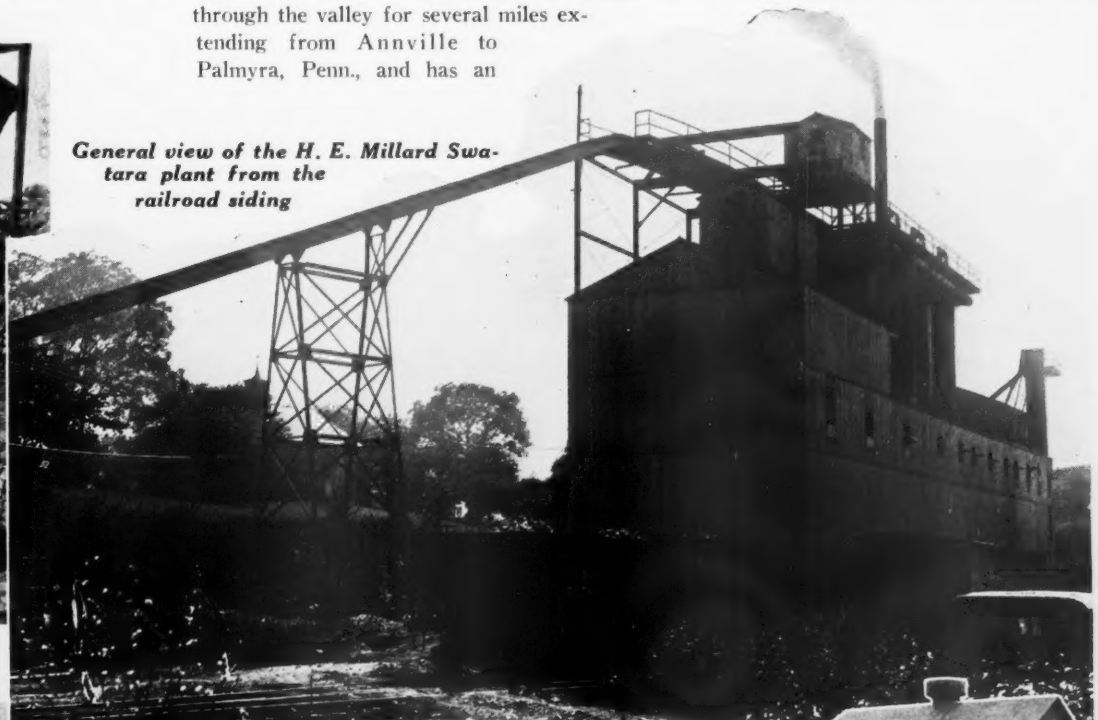
The Lebanon Valley of Pennsylvania, the Scene of a Group of Operations of H. E. Millard

BEFORE PROCEEDING with a description of the operations of H. E. Millard at Annville, Penn.—operations that cover several of the major rock products industries, including burned lime, high calcium cement rock, crushed aggregate and a special pulverized high calcium lime product—a word should first be said about the sole owner of this interesting series of operations. We do not mean to launch into a biography of the man, as a sentence will tell more his fundamental characteristics: He dared to tackle an apparently hopeless task where many had tried and failed before; he has made an unqualified success of it.

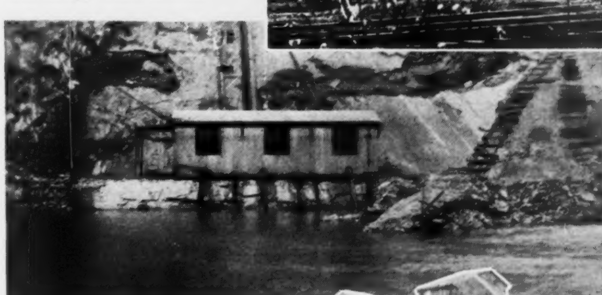
For many years past the cement producing areas in the Lehigh Valley centering around Allentown, Penn., have had need of a high calcium limestone to "sweeten" the cement rock from the quarries in the Lehigh Valley—in other words, the cement rock there is short on lime. Practically all of this high calcium limestone came from the Lebanon Valley, centering at Annville. Operator after operator attempted to quarry this ledge of high calcium stone that strikes through the valley for several miles extending from Annville to Palmyra, Penn., and has an average width of 400 ft., but were compelled to stop operations on account of the excess of water flowing into the quarries. Several of the larger and well financed cement companies attempted operations here, but only a few remnants of their loading plants still remain. The Valley was notorious for the "graveyards" of countless operators who had in times past attempted to recover this rock.

Several of these operations were leased from Mr. Millard, who owns a strip of several thousand acres in the Lebanon Val-

View over top of coke burning lime kilns



General view of the H. E. Millard Swatara plant from the railroad siding



Above, pump house at the Annville quarry. To the right is the crushed stone plant at Millardsville

The crushing and screening plant at the Annville quarry

ley that practically parallels the main lines of the Philadelphia and Reading railroad between Harrisburg and Reading, but finally most of the operators abandoned the quarries and Mr. Millard started operating them himself.

He has in the valley near Annville, 11 quarries or pits, active or inactive, which at one time or another were operated for cement rock. Quarries Nos. 1, 2, 3 and 5 are hand-loading operations. No. 4 is the pit at which is located the crushing plant. The pulverizing plant is not numbered.

A twelfth quarry is maintained at Millardsville, east of Lebanon, Penn. Two other quarries are operated, one at Palmyra and one at Swatara, Penn., along this same ledge of high-calcium limestone that strikes east and west through the valley and which has a dip of about 70 deg. At present, most of the cement rock comes from the Annville quarries, this group having been connected by tunnels or open cuts, so they virtually form one pit, with the enormous amount of water from all the pits draining to a common sump.

One of the first steps that Mr. Millard took was to determine where the tremendous flow of water came from (at the start it ran as high as 25,000 gal. per min.), all of which at times had to be pumped vertically over the quarry rim, a lift of 125 to 150 ft. The question of costs was vital.

Locating the Water Inlet

There are two small creeks that cut through the areas, the larger one being Quittapahilla Creek. Undoubtedly the flow was coming from some pothole or underground channel that drained part of this creek. Rewards of $1000 were posted to any small boy or man who while in swimming in this creek could locate this pothole. Several "wizards" with their divining rods tried to locate the water course, but finally Mr. Millard took direct action himself. He dug a new channel, piecemeal, for this creek and lined it with concrete as he went along, until finally he located the water inlet that led to his quarry—an irregular shaped hole several feet in diameter. Before this hole was found and sealed, the creek bed for 4000 ft. was lined with concrete, making a stream bed 20 ft. wide and 5 ft. deep. How many quarry operators would dare to make such expenditures with such slight margin for success?

H. E. Millard

By sealing the bed of this creek and a second one, Killinger Creek (though much smaller and shorter in length), the flow of water was reduced from 25,000 to 10,000 gal. per min., and operations were put in a better position for financial success.

"Some" Pumping Plant!

The pumps for handling this water are all located in a neat steel and corrugated-iron structure at the Annville quarry, with each pump discharging to a 24-in. header pipe. A separate 8-in. discharge line is also used. The pumps are protected from reversals due to power shut-offs by a check valve located in a small tubular steel chamber located between the pumps and the header. A second 20-in. discharge line, to cut down friction, is being installed paralleling the first, both of which discharge over the rim of the quarry and run to waste.

The sump serving the pumps has sufficient capacity to hold several hours' supply of drainage, after which the water backs over the quarry floor and, owing to the flatness and size of the quarry floor, the pumps would have to be down one-half day or more before they would be endangered. A steel stiff-leg derrick is mounted on the quarry rim for handling repair parts to and from the pump house, while in the pump house itself an overhead I-beam and chain block can carry these parts to the larger stiff-leg derrick.

The schedule on page 51 shows the pumps that are now mounted in the pumping plant. All are direct-connected to their motors and all are of the induction type with the exception of the largest unit, which uses a synchronous motor.

Swatara Lime Operation

Mr. Millard has been for a long time a producer of burned lime, having four plants with 29 shaft kilns. Six kilns were at Annville, six at Myerstown, 13 at Palmyra and four at Swatara, these towns being located

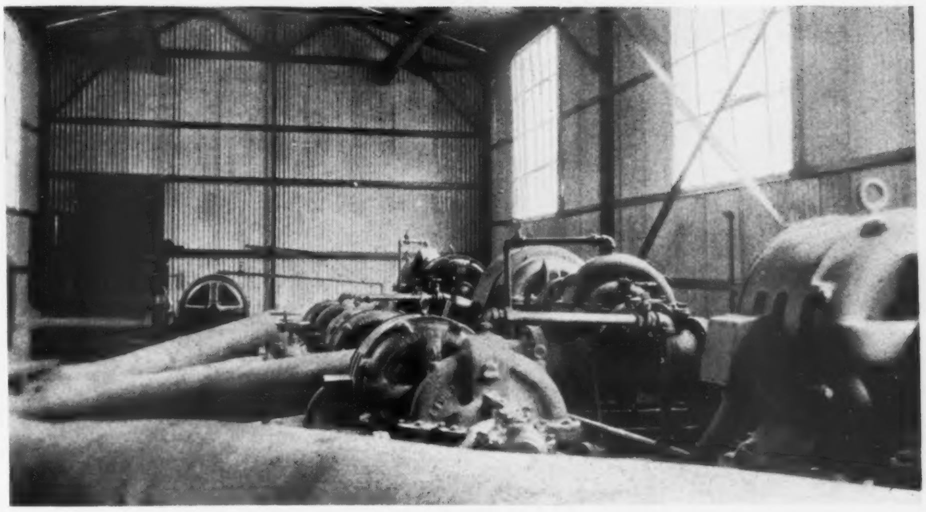
How Mr. Millard handled a difficult surplus water problem at the Annville quarries. The two upper left photos show the way in which he lined one of the creeks that crosses the operations to cut down seepage. The third view shows the discharge from the quarry and the fourth, the pipes which carry the water over the edge

along the strike of the high calcium limestone vein previously referred to; but at present only the Palmyra and Swatara plants are in operation.

Swatara is a small town adjoining the more well-known "model" city of Hershey, the home of the well-known chocolate king, and is about 15 miles east of Harrisburg, Penn., and on the William Penn highway.

The Swatara operation was designed and built in 1927-28 by the McGann Manufacturing Co. for Walter T. Bradley of Philadelphia, and was one of the outstanding lime plants built during that year. In 1929, Mr. Millard purchased the entire holdings of Walter T. Bradley and, owing to the modern features of the Swatara plant, has centralized his operations at that plant. His operations have been so satisfactory that he is at present adding four more Kuntz kilns of the same size as originally in use. The handling of stone at the Swatara plant is also being revamped so that hand loading can be replaced with power shovels. This entails the installation of a set of 4-ft. by 30-in. diameter, McLanahan slugger rolls that discharge to a Stephens-Adamson roll grizzly, the fines going to a screening plant for production of crushed aggregate or high calcium cement rock, and the larger sizes for kiln stone. This oversize falls to a 36-in. belt conveyor that acts as a stacker, building a stock pile 30 ft. high, from which the material can be drawn to cars for hoisting up the incline serving the plant. The new crushing and screening plant is being built across the roadway from the main plant and will be of reinforced-concrete and steel construction throughout.

At Swatara a large pit has been in operation for years, and for supplying the new



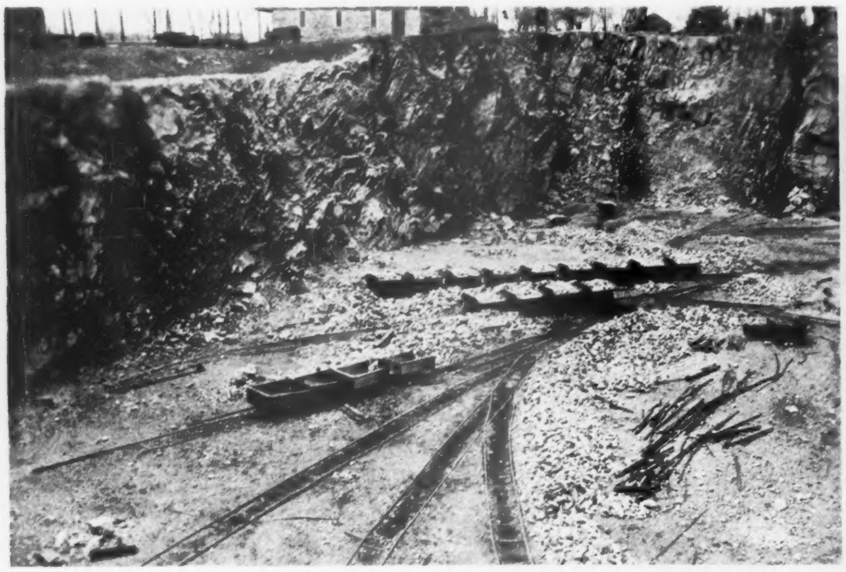
Partial view of the interior of the pump house

PUMPS AND DRIVE MOTORS AT THE ANNVILLE, PENN., QUARRY

Pumps			Motors		
Diameter	Make	Gal. per min.	Make	Horsepower	Number
8-in.	Allis-Chalmers	2500	General Electric	100	1
12-in.	Cameron	3500	Westinghouse	150	1
6-in.	Allis-Chalmers	1000	Allis-Chalmers	40	1
6-in.	Allis-Chalmers	1500	Allis-Chalmers	60	1
Size 8	Cameron	1500	Westinghouse	75	1
12-in.	NFV Ingersoll-Rand	6500	General Electric*	250	1
12-in.	Cameron	5000	Westinghouse	200	1
		21,500			

*Synchronous.

The pump house, located at the edge of the sump to which all quarries at Annville drain



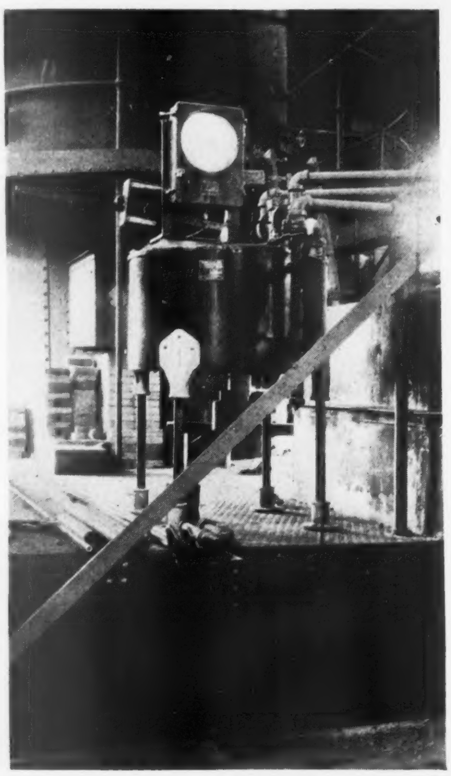
Looking into the Swatara, left, and Palmyra quarries. They convey an idea of the small amount of overburden handled

plant a second one was opened a short distance west of the older pit. As operations from this pit proceed, several substantial dwelling houses to the west of the second pit will have to be removed or torn down to allow the quarry to grow.

In the quarry here operations are simple. Only a few inches of topsoil are removed, after which a Keystone well drill prepares the holes for primary shooting. Koppel cars are hand-loaded and trammed to the incline serving the plant. The pit is at present about 60 ft. deep, with plenty more of high-grade calcium rock to be had below. But this may be more expensive on account of probabilities of encountering more water.

One of the many interesting features of the Swatara lime plant is that the operation is practically mechanical throughout, although hand picking of the burned lime, to remove unburned core, etc., has been provided for by a steel pan conveyor that is used to pass the burned products to storage. Hence from the time the stone is loaded into the top of the kilns until the lime is loaded into cars, there is no manual handling of the material, except picking.

Similarly, the coal is dumped into a track hopper from cars and handled mechanically



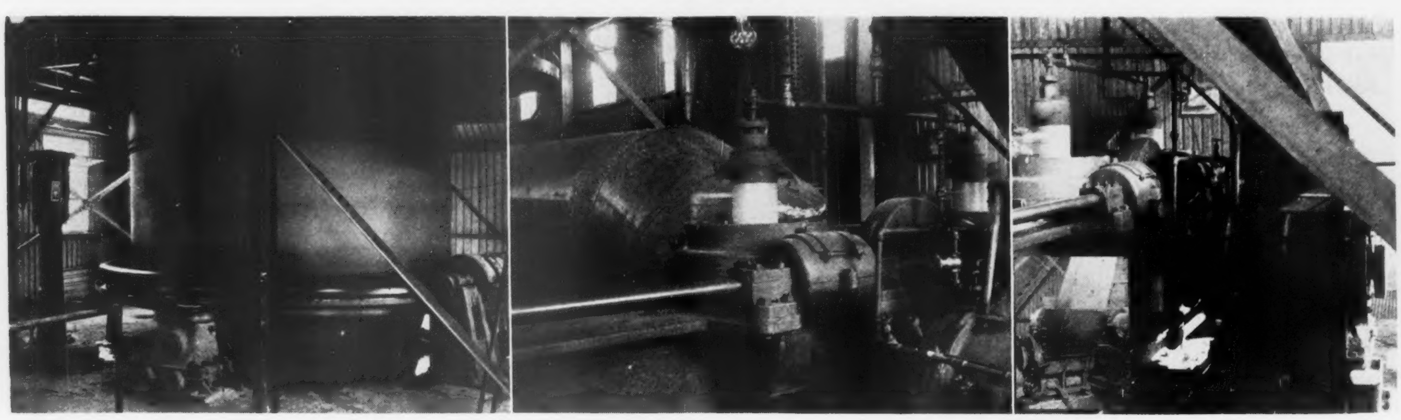
Gas regulator insures uniform flow of gas to the Swatara kilns at all times

throughout its course to storage bin, automatic feeder and the Wood gas producer.

The plant consists of four gas-fired kilns that will soon be increased to eight. Each kiln is 11 ft. in diameter and 60 ft. high and is capable of producing 20 to 25 tons of lime per 24-hour day. The gas for burning is generated by an R. D. Wood, heavy-duty gas producer, capable of gasifying 4500 lb. of coal per hour. This plant was installed originally to provide for doubling the capacity, and in view of the recent developments this was certainly justified. The gas producer is driven by a 7½-hp. General Electric motor through a James spur gear reduction unit. The producer is at the end of the original four kilns, on the same center line, from which the gas passes through a circular flue 4 ft. in diameter, with a soot leg located near the producer. Additional soot legs are provided, each 4 ft. in diameter, one located near the gas inlets to each kiln.

A No. 2, Type B-3, Chowning Regulator Corp. gas regulator is being installed at the producer that will maintain a more even and better flow of gas to the kilns. A Bristol recording pressure gage is also a part of the gas regulator equipment.

Steam is supplied the producer from an



Some interesting views of the gas producer at Swatara. Left, in operation; center, operating mechanism and gas flue, and right, the automatic coal feeder for the gas producer. Inset, in right hand photo, shows opposite side of coal feed

80-hp. Seibert horizontal fire tube boiler located near the gasifier.

The gases from the header enter each kiln through two 2-ft. diameter pipes, one on each side of the kiln and about 5 ft. above the beginning of the cone of the draw. The kilns are all lined with fire brick to the top,

E. D. Williams, general manager of the H. E. Millard operations

Olive Hill fire brick being used. The kilns are all blower induced draft.

The lime is drawn cool enough to handle to a Jeffrey 36-in. apron conveyor running under the kilns, the conveyor extending 25

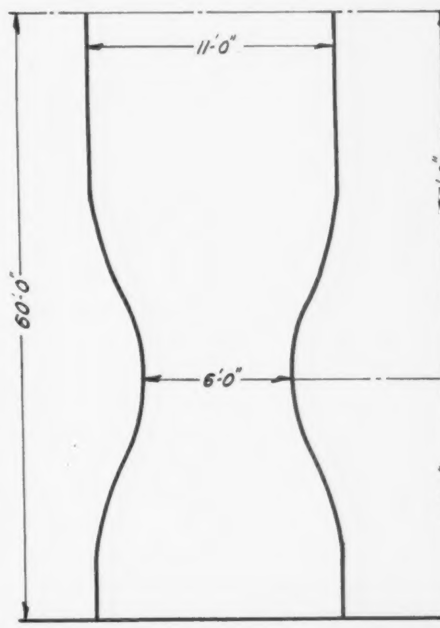
The draw gate and conical hoppers over the pan conveyor, the extension of which is used as a picking table at Swatara

ft. beyond the last kiln to provide opportunity for picking. This conveyor delivers the lime to a Lattimer bucket elevator that serves a small screen, the fines being chuted to a 50-ton steel, air-tight, storage bin, and the lump lime chuted to a second 200-ton cylindrical, cone-bottomed, steel bin.

The lime is drawn from these two steel bins to either of two Link-Belt car loaders and is loaded to cars for shipment.

The coal for use in the gas producer is delivered on the plant siding in hopper-bottom cars. The coal is dropped into a track hopper, from which it is removed by a Jeffrey reciprocating feeder. This delivers to a Jeffrey single-roll crusher, which reduces the coal to $1\frac{1}{2}$ in. and under. The coal is discharged by the crusher into a bucket elevator, which deposits it in a 50-ton storage bin, directly above the gas producer. From this bin it is delivered by a chute to the automatic feeder of the producer. Provision is made, at the top of the elevator, for delivering excess coal to outdoor storage, space for which is provided at the extreme end of the plant.

The plant is well built, with all floor and passageways amply wide for operating con-



Cross-section detail showing dimensions of Swatara kilns of H. E. Millard

Feeding the kiln with stone and a glimpse along the top of the kilns toward the incline at Swatara

venience, and is constructed of steel throughout.

J. Ben Millard, son of H. E. Millard, is superintendent of the Swatara lime plant, and W. R. Bupp is assistant superintendent and engineer.

Coke-Burning Lime Plant

The Palmyra plant is quite old and has 13 shaft kilns, all built of stone. It is an interesting operation, as it is one of the few plants in this country using a mixed feed with coke for fuel.

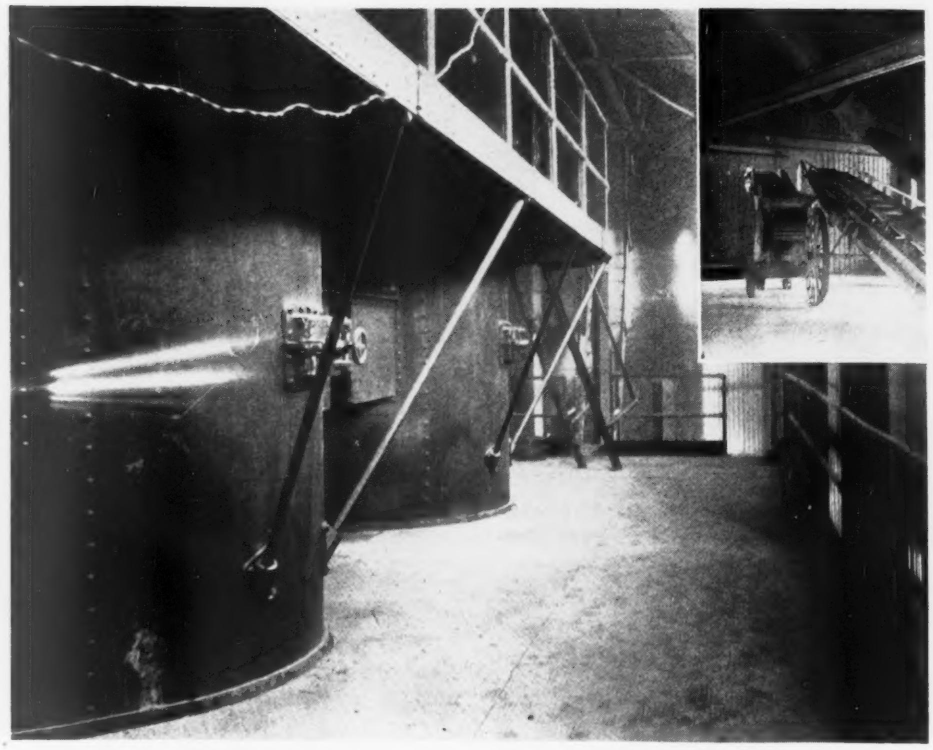
The lime produced from these kilns is of good color and quality, and finds a ready market in steel metallurgical operations, for there seems to be more and more of a tendency to use burned lime in that field wherever possible. The burned lime is favored as it is of less bulk, requiring less tonnage to handle, and it requires less fuel to melt when once in the steel furnaces. Its use also reduces the probabilities of introducing other impurities, as the burned lime is made from high grade and selected rock.

These kilns are 40 ft. high and 10 ft. in diameter, all arranged in a row resembling a crescent. The hand-picked stone from the quarry is loaded into a steel basket holding two tons of stone and is suspended from an overhead I-beam on a suitable trolley. The I-beam passes over each of the kilns so that the basket can discharge direct to any desired kiln.

From seven to ten wheelbarrow loads of coke are used to each charge of stone, with alternately a layer of coke and of stone being spread as needed. The stone is approximately all 6 in. to 9 in. in diameter and the coke is 1½-in. size. When the latter is spread over the charge, it is kept back from the brick work about 8 in., so as not to overheat and fuse the lining. Natural draft is used.

The plant produces 175 tons of burned lime per 24 hours.

The burned lime is drawn to a specially designed hand-operated car built by the Link-Belt Co. The car is moved by means of a hand wheel geared to the wheel's shaft.



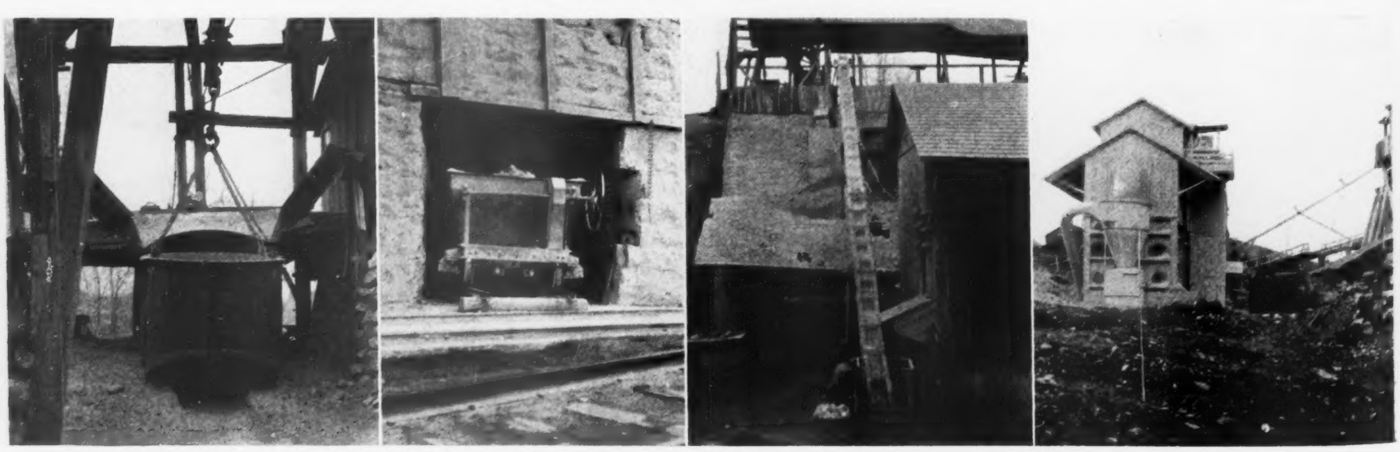
View of operating floor at Swatara looking toward storage end of plant. Inset shows portable conveyors for loading lime

Main offices of H. E. Millard, a short distance west of Annville, Penn., on the William Penn Highway

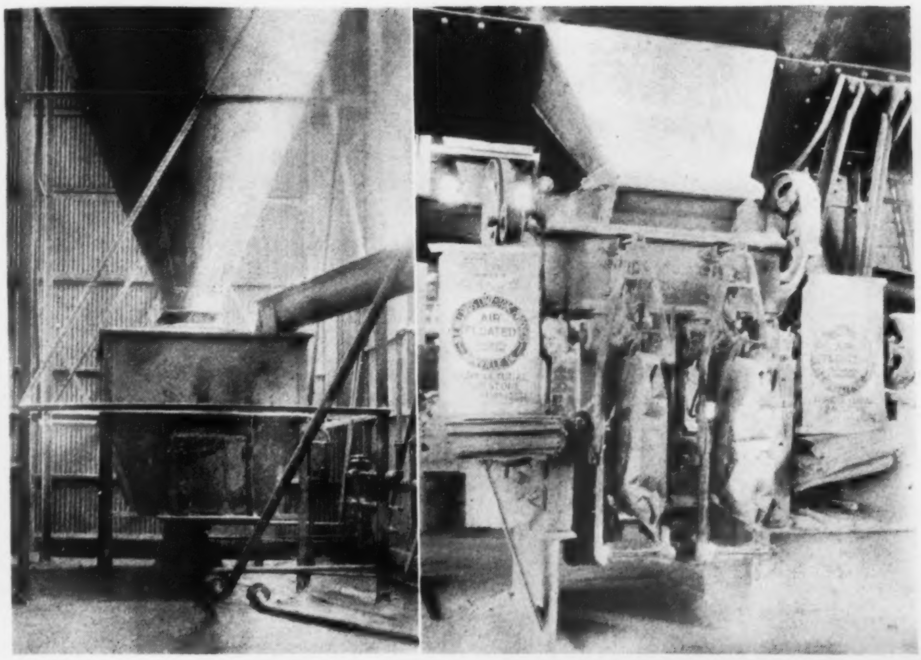
From the car, the burned lime is delivered to the loading plant by a drag conveyor where the lime is elevated to a shaking screen, that sizes the lime into lump and fines and deposits these products in separate bins. From the bins the lime is loaded to cars.

The burned lime as it is delivered to the loading plant is sorted, and the unburned cores picked out and returned to the top of the kilns by the return side of the drag conveyor. The loading plant is provided with a fan and dust collector for collecting and recovering all the dust incidental to the loading operation. This makes a usually obnoxious operation, that of loading dusty lime, a more pleasant and agreeable one.

The quarry at Palmyra has been in operation for many years and extends along the



At the Palmyra, Penn., H. E. Millard lime plant the stone is loaded into the bucket and carried over the kiln on an I-beam for dumping. The lime is drawn to the specially designed cars shown in the second view. After sorting, the unburned cores are returned to the top of the kilns by the conveyor shown in the third picture. At the right is the loading plant which handles burned lime from shaft kilns using coke for fuel



The pulverized product is pumped from the dust collectors, one of which is shown at left, to the sacking machines at Annville

same vein of high-calcium limestone that is quarried at the other pits of Mr. Millard. Hand loading is used and the fines shipped to portland cement mills.

Pulverizing a Limestone to 90% Minus 300-Mesh

About a mile east of the Annville crushed-stone plant, a description of which follows

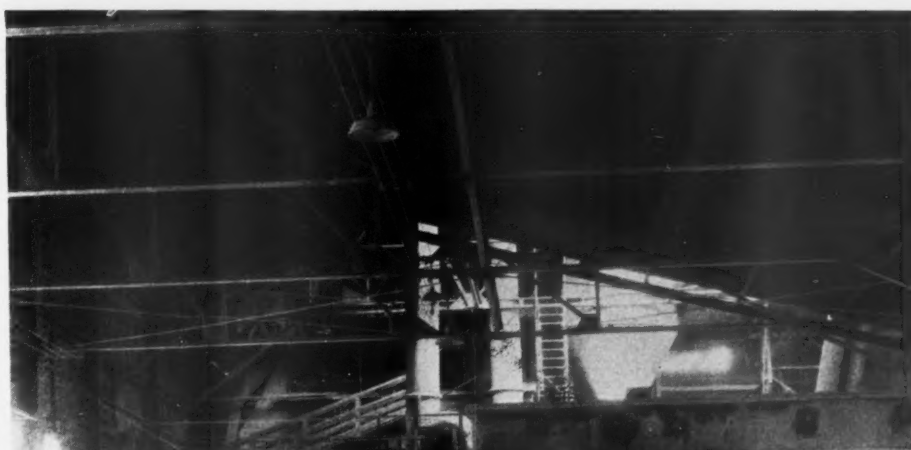
Left to right, Casper Arndt, timekeeper, and J. R. Bomberger, superintendent, of the Annville crushed stone plant

later in this article, the high calcium ledge has been altered, geologically speaking, so that its physical properties are vastly different from the remainder of the ledge. Just what the nature of the geologic activities were that caused this alteration, is debatable, but in any event the product that is now left and used as a source of material for the pulverizing plant is soft, similar to a talc in physical appearance, yet its chemical composition is 97 to 98% calcium carbonate.

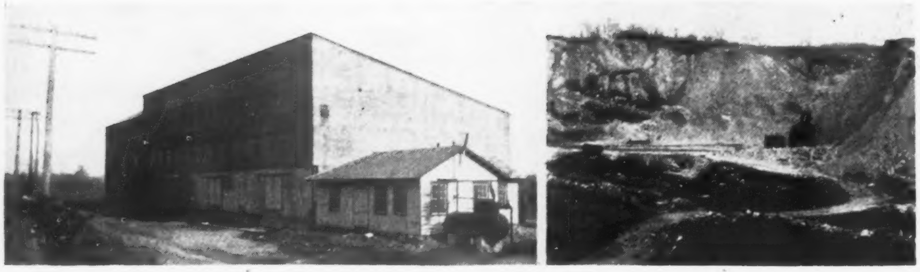
The material from the pit almost can be crushed in the hand to a fine impalpable powder of talc-like dust, and as a result of this peculiar property, Mr. Millard is able to produce a pulverized limestone that can be reduced to 90% through a 300-mesh screen. The bulk of the material, however, is pulverized so that 85% will pass a 200-mesh screen and 100% through the 100-mesh.

The chemical composition ranges from 97% to 98% $CaCO_3$ with 1% magnesium carbonate. The residue is insoluble material.

The larger part of the tonnage from the pulverizing plant is used for agricultural limestone. The balance of the plant's production is used for various chemical purposes and for asphalt fillers, and for coal-mine dusting. The market is such that Mr.



The warehouse at Annville is of reinforced concrete and steel. The pulverizing equipment is shown in the rear



The pulverizing plant at Annville and the quarry which supplies the raw material

Millard expects to be able soon to keep the plant running to its full capacity of 100 tons per day. The plant is now three years old.

This material requires no shooting and can be dug readily from the pit by the ½-yd. Marion steam shovel, used for loading. The cars are pulled up an incline to a No. 6 Traylor gyratory crusher that discharges to a 30-in. Link-Belt all-steel bucket elevator to a storage bin. From the storage bin the limestone is fed to a 6-ft. by 50-ft.

A small laboratory is part of the crushed stone operation

Ruggles-Coles rotary dryer. The dried material falls to an 8-in. screw conveyor serving an enclosed bucket elevator that discharges to a bin serving the Bethlehem pulverizer.

This pulverizing unit has a capacity of 10 tons per hour when reducing this material to the maximum fineness of 90% through a 300-mesh screen. The pulverizer is fed with material that ranges in size from 1-in. down to dust.

The pulverizer is equipped with a No. 60, type SP, Clarage fan so that all the material in the pulverizer must be ground to a predetermined fineness before the fan can lift it out of the mill and pass the dust to the cyclone dust collector. The dust collector discharges to a short screw conveyor that feeds a parabolic steel bin, under which is installed a 3-in. Fuller-Kinyon pump. The pump delivers the dry dust to a 2-tube Bates packer, where the material is sacked in 80-lb. multi-walled paper bags for shipment. The pump can also deliver the pulverized

End view of the crushing and loading plant at Annville, which is served from the primary crushing plant in center picture by a long incline using skips. The lower view shows a new loading plant for transferring high calcium rock direct from the quarry to cars. This rock is shipped to the cement mills in the Lehigh Valley for sweetening purposes

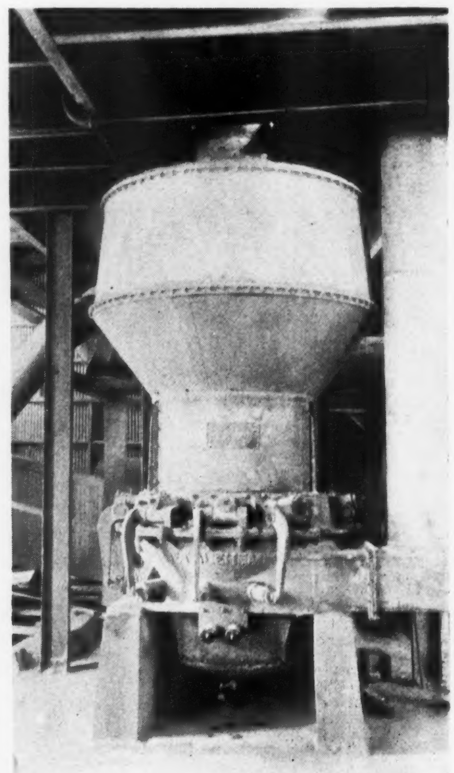
limestone direct to cars for bulk shipment through a separate 3-in. line.

As the dried material falls from the dryer into the previously mentioned 8-in. screw conveyor, considerable dust present is there removed by a small fan which discharges to the cyclone collector over the Fuller-Kinyon pump.

The Bethlehem pulverizer, elevators and dryer are all driven from a line shaft by a 100-hp. synchronous General Electric motor. The other units in the plant are direct-connected to induction motors.

Annville Crushed-Stone Plant

This operation is the principal crushed-stone and cement-rock producing unit in the group owned by Mr. Millard and is a short



The pulverizer at Annville produces a finely divided high calcium lime that has unusual properties

distance north of the main offices. Operations have been conducted here for many years until a great gash has been cut in the limestone, almost a mile long and about 125 ft. deep. The excavation takes up the entire width of the high calcium ledge of about 400 ft. The limestone ledge has a hanging wall and a foot wall of dolomitic limestone along its entire length, but only the calcite is recovered during regular operation. However, the dolomite walls are satisfactory material for commercial aggregate or railroad ballast.

There is about 8 ft. of topsoil, most of which is removed by a Marion electric 2-yd. dragline, mounted on crawler treads; the balance of the overburden is removed by hand. Some of the topsoil is sold locally.

There are three Keystone, a steam and two electric well-drill rigs, and two Loomis electric well drills for primary drilling.

The stone is loaded by a No. 37 Marion electric 2-yd. shovel, mounted on crawler treads, that loads to 5-ton cars of the Western type, and is hauled to the crushing plant by a gasoline-powered locomotive.

A No. 1 Kennedy-Van Saun gyratory crusher is used for primary crushing. This unit rests on the quarry floor and receives its feed direct from the cars with the crusher discharge product falling to a short belt conveyor serving a pair of balanced skips. The skips are used to elevate the crushed stone to the screening and loading plant on the rim of the quarry above.

The skips are loaded by an operator from a chute, but discharge automatically to a grizzly having 3-in. openings. The oversize can be chuted direct to gondolas and shipped for cement rock or can be chuted to a No. 5 or a No. 6 Kennedy-Van Saun gyratory crusher for further reduction, so as to prepare the rock for aggregate.

Stone from the other quarries of Mr. Millard can be hauled to this plant in standard-gage railway gondolas and discharged direct to the two secondary crushers if need be.

The fines from the 3-in. grizzly fall to a concrete hopper that feeds a belt conveyor running under the loading track. The conveyor discharges to the boot of a bucket elevator, where the throughs from the secondary gearless crushers join those from this conveyor.

The 5-ft. by 30-ft. rotary screen is mounted over reinforced concrete bins that receive the 1-in., 2½-in., chips and dust, which are the sizes of aggregate produced. These can be loaded direct to cars or to motor trucks.

Considerable tonnage of crushed and sized stone is carried in stockpiles, which are built up by means of Mack trucks that are driven over the tops of the stockpiles and dumped. Incidentally, the Mack trucks are all being refitted with pneumatic tires in the shops of Mr. Millard. Reclaiming is done by a Marion crane using a 1-yd. clamshell bucket.

The top picture, store house and compressor building at Millardsville; center, garages at Annville, and, lower view, some of the employes' cottages at Millardsville

This crushing plant, which is now four years old, is being augmented by the installation of additional equipment so that a cleaner product can be produced. This new installation includes log washers and more screening capacity, and is designed so that either a dry screened or washed product can be obtained.

In the office of this plant, a small laboratory is maintained so that the lime carbonate content of the stone from all of Mr. Millard's quarries can be determined. This is an unusual feature for a crushed-stone plant.

Millardsville Operation

This plant and quarry is located in a small village referred to as Millardsville, a few miles east of Lebanon, Penn. It is one of the oldest operations controlled by Mr. Millard, having been started by his father.

Most of the pit has been allowed to fill up with water and only that stone above the water level is being recovered at present, but pumps are available should it become necessary to re-enter the pit for additional limestone. These pumps have a capacity of 5000 gal. per min. At present, only a part of the loading equipment is being used, but there are available five No. 41 Marion steam shovels which have been converted to traction wheel types, and a No. 21 Marion steam shovel. These load to Western 5-yd. side-dump cars. Both Vulcan and Baldwin steam locomotives are used for transporting the stone from the quarry face to the plant.

In the crushing plant, Kennedy-Van Saun gearless gyratory crushers and rotary screens are used throughout. The jackets on the rotary screens are equipped with Taylor-Wharton Iron and Steel Co. manganese steel perforated plates.

A 30-in. gyratory crusher is used as a primary unit, which is served by a 36-in. belt conveyor, receiving its feed direct from a chute at the crusher's discharge. The inclined belt conveyor elevates the stone to the top of the plant, where it falls to a bar grizzly, the oversize from which can go either to bins, to gondolas or to a No. 6 crusher. In the event the oversize goes to the secondary crusher, the crushed material falls to a bucket elevator and is elevated to a 5-ft. by 25-ft. rotary screen.

The fines from the bar grizzly fall to a

Steam locomotive and side-dump cars are used at Millardsville. Center, part of the quarry face above water at Millardsville. Right, stripping at one of the Annville quarries

belt conveyor and are also delivered to the feed end of the rotary screen.

The inner barrel of this screen has 6 ft. of 2-in. round perforations and the balance of its length has 3-in. round openings. The outer jacket has all 1½-in. round perforations. The material from this jacket falls to a bin and is elevated to a second rotary screen, where chips, 1-in. and 2-in. sizes, are produced.

Adjoining the plant are many well-kept and neat-looking homes for the employes of Mr. Millard, which are rented to the men at nominal rates.

Besides the rock products industries that Mr. Millard controls, he operates a flour mill, a multitude of farms adjoining the five-mile strip of land, and is a large holder of residential and business properties in the Lebanon Valley. His home, near the office, about a mile west of Annville, on the William Penn highway, is one of the largest and most attractive homes in the district.

Personnel

E. D. Williams is general manager of H. E. Millard's operations. U. S. Blecher is secretary and purchasing agent, D. K. Shroyer is sales manager, J. R. Bomberger is superintendent of the Annville quarries and crushed-stone plant, and C. W. Dunlap is in charge of the Millardsville plant and quarry.

Dust and Health

HEALTH PRACTICES Pamphlet No. 4, published by the National Safety Council, discusses the whole relation of dust to health and preventative measures, such as the use of respirators and dust-collecting systems. A classification of dusts shows that, aside from the poisonous dusts such as lead and arsenic, silica dust (crystalline silica dioxide), is the only one that is extremely dangerous in ordinary quantities and in the ordinary sizes of dust particles.

Silica dust is produced wherever such rocks as granite, quartz, sandstone and quartzite are quarried or crushed or ground. The diseased condition that results from breathing silica dust has been given a definite name, *silicosis.* Such rock dusts as those of limestone, talc, feldspar, the silicates in which silica is combined with other elements, and even emery and carborundum, do not cause silicosis or any condition resembling it. Emery and carborundum penetrate the lung tissue but they remain inert and cause no reaction. Limestone and coal dusts are the least harmful.

The fine hairs on the lining of the windpipe and the bronchial tubes and the mucus secreted dispose of much of the dust that is inhaled, but a certain amount gets past these and is carried into the lung tissue. Then it has to be removed by the blood stream and the lymph stream. The white blood corpuscles envelope dust particles and carry them through the lung tissue so that they may be disposed of by the lymphatic circulation. But the corpuscles may be carried to the lymphatic glands at the roots of the lungs and accumulate sufficiently to stop migration. X-ray photos show that spots form at first and later the accumulations show as strands when the condition known as fibrosis is reached.

Silica particles dissolve slowly within and react chemically on the cells containing them, causing cell death and mummification. The dead cells clog the lymph passages and glands. Here they disintegrate and distribute the dissolved silica and the final result is the formation of scar tissue which replaces the normal lung tissue.

Experiments have shown that the same results follow when soluble silica is injected into the body, but they come more quickly. Soluble silica reacts with the cells of the liver, causing scar tissue there, and also with the cells of the kidneys. Bright's disease is prevalent among workers who breathe silica dust. But the most serious effect seems to be that the dead tissue forms a medium in which tuberculosis germs readily flourish. Even after the sufferer from silicosis has been withdrawn from exposure to the dust, the silicotic process has been found to go on to a fatal termination without further exposure.

Dusts may be kept out of the air by wetting down and by the use of oil and by jets of water and steam. These methods may be used in rock drilling, mining, blasting, stonecutting, stone-crushing and grinding. In some industries machines can be enclosed in air-tight cases, but in most industries exhaust systems must be installed to take the dust away from the worker. The usual dust-collecting methods, the use of cyclones, filtration of the air through fabrics and electrical precipitation have been found efficient.

Respirators have been systematically studied by the U. S. Bureau of Mines. While the laboratory efficiencies of the respirators seem low, it is concluded that respirators are of much value in removing dust from the air that is breathed.

The great disadvantage of a respirator is its discomfort. It was found that a man wearing a gas mask could work hard for only half an hour. A respirator has less resistance than a gas mask to breathing, but it interferes seriously with a man's exertions when it becomes clogged and then it must be removed and cleaned. Respirators are tested with tobacco smoke and if found 50% efficient are considered satisfactory for dusts. This shows how closely woven the fabric must be.

Although the pamphlet gives the details which are necessary to make a respirator both efficient and practical, it concludes that "Although the use of respirators should be encouraged in dusty industries, a respirator cannot be considered a final safeguard."

Protection by law is discussed and it is noted that: "Industrial laws must be scientifically sound. Fundamentally the law is for the protection of the worker, but, on the other hand, in forming such a law the effect on industry and the cost of production must be considered. The elimination of all dustiness in the work processes where there is a dust hazard may be desirable, but there is no scientific reason for such a requirement if the dust itself is not a specific poison." The education of the worker is shown to be necessary, for without it much of the value of the protective measures provided will be lost.

The methods used in studying dusty conditions and their betterment are also discussed.

Sand-Lime Brick Production and Shipments in May

THE following data are compiled from reports received direct from 21 producers of sand-lime brick located in various parts of the United States and Canada. The number of plants reporting is two more than those furnishing statistics for the April estimate, published in the May 10 issue. The statistics below may be regarded as representative of the entire industry in the United States and Canada.

Production continues to increase; on shipments, those by rail showed a slight decrease, while there was an increase in truck shipments. Stocks on hand also increased somewhat as did unfilled orders.

The following are average prices quoted for sand-lime brick in May:

Shipping point	Plant price	Delivered
Atlantic City, N. J.	$12.00	$17.00
Boston, Mass.	11.00	14.50
Dayton, Ohio	12.50	15.50
Detroit, Mich.	....	15.50@16.00
Detroit, Mich.	13.00	15.00
Grand Rapids, Mich.	14.50	....
Iona, N. J.	12.00	15.00
Jackson, Mich.	13.00	
Menominee, Mich.	11.00	13.50
Milwaukee, Wis.	10.50	13.00
Minneapolis, Minn.	9.00	11.00
Mishawaka, Ind.	11.00	....
Pontiac, Mich.	12.50	15.50
Saginaw, Mich.	12.00	....
Sioux Falls, S. Dak.	12.50	....
Syracuse, N. Y.	18.00	20.00
Toronto, Can.	11.00	13.00
Winchester, Mass.	....	15.00

The following statistics are compiled from data received direct from 21 producers of sand-lime brick in the United States and Canada:

Statistics for April and May

	*April	†May
Production	9,802,166	12,708,293
Shipments (rail)	3,910,255	3,272,153
Shipments (truck)	5,623,957	7,558,562
Stocks	11,504,517	12,975,203
Unfilled orders	9,229,000	10,706,000

*Revised to include four plants not reporting in statistics published in May 10 issue. Nineteen plants reporting; incomplete, one plant not reporting production, and eight not reporting unfilled orders.

†Twenty-one plants reporting; incomplete, two not reporting stocks on hand, and seven not reporting unfilled orders.

Overcoming Heat Losses in Cement Manufacture

Recent Research Work on Cement Kiln Design With Special Reference to Dust, Spray, or Flotation Kilns

By Geoffrey Martin, D.Sc. (London and Bristol)
Ph.D., F. I. C., M. I. Chem. Engineer, M. I. Struct. Engineer
Late Director of Research of the British Portland Cement Research Association

FOR MANY YEARS it has been well known that the rotary kiln, as at present designed, is extremely inefficient from a thermal point of view.

Thus an ideal kiln could yield 100 tons* of cement clinker by the combustion of 6.35 tons* of standard coal. In actual practice 100 tons* of clinker require anything from 22 tons* of coal (dry process) to 30 tons* of coal (wet process); and these figures are usually immensely exceeded in most works.

Consequently many efforts have been made to construct kilns of greater thermal efficiency. A brief account may therefore be interesting of recent efforts in this direction.

Before explaining the nature of these efforts a few words must be said regarding recent discoveries concerning the *causes* of the relative inefficiency of cement kilns because all these efforts for improvement are largely based on the discovering of what is wrong in existing kilns.

It should be mentioned that the main portion of this paper is based upon research work carried out by the writer when director of research of the British Portland Cement Research Association, between 1922 and 1925.

Since the closing down of the Research Association in 1925 (following on the tragic death of the late H. C. K. Bamber, one of the foremost advocates for scientific research in the British cement trade) the research work was continued privately by the writer, with the results set forth below.

Requirements of a Cement Kiln

A cement kiln to be commercially successful should (1) be thermally efficient; (2) possess a large output. Thermal efficiency without output does not lead to commercial success.

For example, the shaft kiln is considerably more thermally efficient than a rotary kiln and yet rotary kilns have replaced shaft kilns almost everywhere, except in a few countries where labor is very cheap and fuel very dear.

A good shaft kiln can, under suitable circumstances, produce 100 tons* of clinker from 14 to 18 tons* of standard coal (of 12,600 B.t.u.'s per lb.) against 22 to 30 tons* of coal from a rotary kiln, both working the dry process.

The disadvantage of the best shaft kilns, however, is their low output—say, 150 tons* a week against 1000 to 2000 tons* a week of a modern cement kiln with even less labor than is requisite for a shaft kiln.

Now why is a shaft kiln more thermally efficient than a rotary kiln?

In order to explain this we must go into the thermal history of portland cement clinker.

Thermal History of Portland Cement Formation

In order to make portland cement we must heat a mixture of clay and calcium carbonate

*Tons as used in this article are English tons of 2240 lb. To convert the figures to American tons of 2000 lb. multiply by 1.12.—Editor.

General view of Asheham works where large scale experiment in testing kilns was carried out by a group of English financiers. Boiler house is on top of the hill and raw material drying plant at the base

(chalk, limestone, etc.).

But the heat must be supplied in a definite way. We must not only supply a certain *quantity of heat,* but we must also supply it at the right thermal pressure (or temperature as physicists say).

In order to see this let us now follow the thermal history of a batch of raw material through the kiln.

As water plays no part in the formation of cement and is a mere mechanical admixture, it simplifies the treatment of the subject to consider that the mixture is dry at a temperature of 60 deg. F. (15.6 deg. C.).

Assume that this batch of raw material consists of:

1.1905 lb. of calcium carbonate ($CaCO_3$)
0.1846 lb. of kaolin ($Al_2Si_2O_7 \cdot 2H_2O$)
0.1540 lb. of hydrated silica (93% SiO_2, 7% H_2O)
0.0312 lb. of ferric oxide (Fe_2O_3)

Total: 1.5603 lb.

This mixture when ignited to about 2498 deg. F. (1370 deg. C.) will form 1.00 lb. of cement clinker of the ordinary manufactured in Great Britain.

As the temperature (or thermal pressure) of this 1 lb. mass of raw material increases —i. e., as it becomes hotter and hotter—different quantities of heat are absorbed; or, so to speak, are pumped into the material at different temperature levels (or better, at different thermal pressures).

The accompanying Table I shows this, which I have calculated from data compiled by the British Portland Cement Research Association.

Necessary to Force Different Quantities of Heat at Different Thermal Pressures

By studying this table you will see that between 32 deg. and 212 deg. F. the raw material must have forced into it a quantity of heat measured by 70.29 B.t.u. So that from a practical point of view 70.29 B.t.u. must be pumped into the raw material at a *thermal pressure not below* 212 deg. F.

Next between 212 deg. F. and 1481 deg. F. you will see that the material must have forced into it an additional 534 B.t.u

So that the kiln designer must arrange matters that this number of B.t.u. must be available from the surrounding heating medium at a thermal pressure between 212 deg. and 1481 deg. F.

Next at 1481 deg. F.—the temperature at which the calcium carbonate begins to decompose and evolve carbon dioxide—the material must have pumped into it no less than 812 B.t.u. delivered at a thermal pressure *above* 1481 deg. F.

If these B.t.u. are available from the heating medium at a *lower* thermal pressure than 1481 deg. F. they are of no practical value so far as decomposing the calcium carbonate and expelling the CO_2 therefrom is concerned. At a lower thermal pressure than 1481 deg. F. the B.t.u. simply cannot be pumped into or absorbed by the material, and they pass away through the kiln unabsorbed and without doing any useful chemical work, and escape up the chimney to the air unutilized; merely increasing the exit temperature of the kiln gases in so doing.

Finally about 107 B.t.u. must be forced into the material between 1581 deg. F. and 2498 deg. F. in order to cause the lime and silica to chemically unite to form the mixture of calcium silicates known as portland cement clinker. And if these 107 B.t.u. are not available from the surrounding heating medium at a thermal pressure of about 2500 deg. F., then no cement clinker is formed, no matter how many millions of B.t.u. are forced through the kiln or how many tons of coal are burned.

This fact was strikingly illustrated some years ago by costly large-scale experiments carried out by the Associated Portland Cement Manufacturers at their Swanscombe Works by Eldred. He obtained hot gas derived from a producer, and lowered the temperature of the gas below 2500 deg. F., by mixing exit gas with it, and forced the mixed gases through a rotary kiln fed with slurry. The material came out merely underburnt, and the exit temperature at the end of the kiln shot up; while the fuel consumption increased enormously.

These experiments cost nearly £5000 and demonstrated the impossibility of making cement by these methods.

Heat Available Above 1481 Deg. F. Valuable in Cement Clinker Formation

It will be seen, then, that the temperature of 1481 deg. F. (805 deg. C.) is a critical temperature at which a great deal of heat is absorbed in the cement kiln at a very high thermal pressure or temperature, because it is the temperature at which the calcium carbonate decomposes.

Hence the kiln may be conveniently divided into two parts—a portion *A* where the temperature of the raw material is above 805 deg. C. (1481 deg. F.) and a portion *B* where the temperature of the raw material is *below* 1481 deg. F.

So that in making 1 lb. of cement clinker the raw material mixture must be subjected to a steadily increasing temperature starting at 60 deg. F. and finishing at about 2498 deg. F., and the dry raw mixture must absorb 652.5 B.t.u. below 1481 deg. F. and 918.6 B.t.u. *above* 1481 deg. F. *before* 1 lb. of cement clinker can be formed.†

Since 1481 deg. F. (808 deg. C.) is the temperature whereat the calcium carbonate begins to decompose in the furnace, obviously no clinker can be formed until the chalk *does* decompose. So that any heat escaping unutilized past the line dividing the *A* portion of the kiln from the *B* portion is completely lost so far as cement formation is

TABLE I—QUANTITY OF HEAT ABSORBED BY THE SOLID RAW MATERIALS IN MAKING 1 LB. OF PORTLAND CEMENT CLINKER BEWEEN 32 DEG. F. AND THE CLINKERING TEMPERATURE 2498 DEG. F.

t deg. F.	Quantity of heat in B.t.u.			
32 deg.	0			70.29 in drying zone
212 deg.	70.29	beginning of 212 deg.	Due to splitting off of water	
212 deg.	77.09	end of 212 deg.		
312 deg.	117.60			534.20 B.t.u. in preheating
412 deg.	158.04			
512 deg.	198.59			
612 deg.	239.02			
712 deg.	279.57			
812 deg.	320.01			
912 deg.	360.54			
1012 deg.	400.89			
1112 deg.	441.42	at beginning of 1112 deg.	Due to splitting off of water from kaolin	
1112 deg.	455.32	at end of 1112 deg.		
1212 deg.	495.68			
1312 deg.	536.08			
1412 deg.	576.47			
1481 deg.	604.49	at beginning of 1481 deg.		
1481 deg.	1416.41	at end of 1481 deg.	811.92 B.t.u. absorbed owing to evolution of CO_2 by $CaCO_3$	*Decarbonating zone*
1581 deg.	1444.61	Sintering zone	286.70 B.t.u. absorbed in heating the raw materials up to 2498 deg. F. and 179.93 deg. B.t.u. are evolved when chemical union takes place, making net absorption 10677 B.t.u.	
1681 deg.	1472.81			
1781 deg.	1501.01			
1881 deg.	1529.21			
1981 deg.	1557.41			
2081 deg.	1585.61			
2181 deg.	1613.71			
2281 deg.	1641.91			
2381 deg.	1670.21			
2481 deg.	1698.31			
2498 deg.	1703.11	at beginning of 2498 deg.	Due to exothermic reaction	
2498 deg.	1523.18	at end of 2498 deg.		

†It should be carefully noted that it is a fallacy to state that the total minimum quantity of heat required to make 1 lb. of cement clinker is 652.5 + 918.6 = 1571.1 B.t.u., because this statement takes no account of the quantity of heat recoverable from the hot clinker and evolved gases. Heat is, so to speak, pumped *into* the raw material from the external surroundings, but much of this heat flows, so to speak, *through* the material and escapes back at a lower temperature level (or thermal pressure) to the external surroundings again. In much the same way that a stream of high pressure water flowing through a turbine escapes at a low pressure after having done its work —the work being done by loss of pressure. So also in cement formation the main amount of work is done by the B.t.u.'s losing their temperature or thermal pressure, the quantity of heat being not very greatly altered thereby.

concerned—the heat thus escaping being merely employed in preheating and drying the raw material preparatory for its conversion into clinker, but the bulk of it escapes unutilized up the chimney, as just explained above. The quantity of clinker formed, therefore, is measured by the amount of heat absorbed by the raw material between 1481 deg. F. (805 deg. C.) and the clinkering temperature 2498 deg. F. (1370 deg. C.).

But in a cement kiln practically all heating is effected by means of the hot gas evolved from burning coal or oil. Consequently this quantity of heat, absorbed by the raw material between 2498 deg. F. and 1481 deg. F., must in the ideal case be equal to the amount of heat given out by the hot gas between the time of entering the kiln portion *A* and leaving it for the portion *B,* since it is the hot gas which is the heating agent.

Now 1 lb. of standard coal (12,600 B.t.u. per lb.) yields 11.278 lb. of hot combustion gas. If this combustion gas from 1 lb. of coal enters into the section *A* of the kiln at its maximum temperature *T* deg. F. and leaves the section *A* at the temperature of 1481 deg. F. (805 deg. C.), the amount of heat given up by the 11.278 lb. of combustion gas passing down the section *A* is:

$Q = 11.278 \times S \times (T\text{-}1481 \text{ deg.})$ in B.t.u.

where S is the mean specific heat of the combustion gas.

But the amount of heat required to be absorbed by the raw material in making 1 lb. of clinker between 1481 deg. F. (805 deg. C.) and the clinkering temperature of 2498 deg. F. (1370 deg. C.) is 918.6 B.t.u. Therefore, we get the weight in pounds of clinker W formed by the 11.278 lb. of hot gas derived from 1 lb. of standard coal in the section *A* as:

$$W = \frac{11.278 \times S \times (T\text{-}1481 \text{ deg.})}{918.6} \text{ lb.}$$

Connection Between Flame Temperature and Clinker Output

In the accompanying Table II, I have calculated the number of B.t.u.'s liberated by the 11.278 lb. of combustion gas evolved from 1 lb. of burning coal, when it cools from a given temperature *T* deg. F. to 1481 deg. F., and the number of pounds of clinker which can be produced therefrom theoretically, also the number of tons* of standard coal (of 12,600 B.t.u. per lb.) consumed per 100 tons* of clinker produced.

The highest possible flame temperature theoretically attainable by this gas is 5370 deg. F. (2966 deg. C.), which occurs when the combustion air is preheated by the escaping clinker to 2500 deg. F. (1371 deg. C.).

A study of this table shows forcibly the correctness of the contention put forward above—namely, that it is not only the *quantity of heat* which counts, but even more so the thermal pressure (or *temperature* as physicists call it), at which the heat is delivered to the substance.

For example, 100 B.t.u. of heat available at a thermal pressure of 212 deg. F. are much less valuable than 100 B.t.u. available at, say, 2600 deg. F.

TABLE II—CONNECTION BETWEEN FLAME TEMPERATURE AND CLINKER OUTPUT

Temperature of gas derived from combustion of 1 lb. of standard coal of 12,600 B.t.u. per lb.		Number of B.t.u. liberated by 11.278 lb. of combustion gas falling from *T* deg. F. to 1481 deg. F. (805 deg. C.)	Number of lb. of clinker producible per 1 lb. of standard coal burnt	Tons of standard coal consumed per 100 tons* of clinker produced
Deg. F.	Deg. C.	B.t.u.	Lb. clinker	Tons* coal
5370	2966	14,452	15.73	6.36
4100	2260	9,301	10.125	9.88
3000	1649	5,115	5.568	17.96
2900	1594	4,759	5.181	19.30
2800	1538	4,405	4.795	20.85
2700	1482	4,053	4.413	22.66
2600	1427	3,704	4.032	24.80
2500	1371	3,358	3.656	27.35
2400	1315	3,016	3.283	30.46
2300	1260	2,677	2.915	34.30
2200	1204	2,341	2.549	39.25
2100	1149	2,007	2.185	45.77
2000	1093	1,676	1.824	54.82
1900	1038	1,347	1.466	70.13
1800	982	1,021	1.111	90.00
1700	926	698	0.760	131.58
1600	871	378	0.411	243.31
1500	815	60	0.065	1538.46
1481	805	0	0.00	Infinite

In the one case 100 units of heat will produce no cement clinker at all, and in the other case the 100 units of heat can be converted into an equivalent amount of clinker.

The case is analogous to the thermal phenomena involved in the formation of steam in a boiler. For example, millions of B.t.u.'s passed through the heating flues of a boiler at a temperature below the boiling point of water (100 deg. C. or 212 deg. F.) will not generate steam. The elevation of the temperature of the heating gases above 212 deg. F. is what decides the value of the heating medium so far as steam raising is concerned.

In the same way in cement production, the value of the gaseous heating medium for producing cement clinker is measured by the number of B.t.u.'s available *above* 805 deg. C. (1481 deg. F.).

For the sake of convenience the B.t.u.'s available *above* 805 deg. C. (1481 deg. F.) are called "high grade" heat, and B.t.u.'s available *below* 805 deg. C. are called "low grade" heat.

It will also be seen that the ordinary thermal balance of the rotary kiln is practically valueless from a technical point of view because the quantities of heat are all expressed as so many B.t.u.'s without distinguishing whether these B.t.u.'s are available at a high or low thermal pressure or temperature.

For example, the table shows us that when the flame temperature is only 1481 deg. F., it is necessary to burn an infinite amount of coal in order to produce an ounce of clinker. Whereas, when the flame temperature is at its maximum of 5370 deg. F. (2966 deg. C.) we can produce 100 tons* of cement clinker by the expenditure of only 6.36 tons* of standard coal. With a flame temperature of 2600 deg. F. we could produce 100 tons* of clinker by the combustion of 24.8 tons* of standard coal—which is practically obtained in many cases.

It is no exaggeration to say that ignorance of this factor has been largely responsible for the lack of progress in cement-kiln design and construction during the last 30 years. Many costly experiments have been carried out which (it could have been predicted beforehand) were doomed to failure because the designers were unaware of this fundamental fact of thermodynamics—for example, Eldred's experiments mentioned above.

Radiation Losses of the Thermal Units Available at High Thermal Pressures (or Temperatures) Are Main Causes of Cement-Kiln Inefficiencies

We are now in a position to discuss the question: Why is a shaft kiln so much more efficient than a rotary kiln?

The main reason is undoubtedly due to the greater external and internal radiation losses in one case than in the other. It is the radiation losses which are the main cause of inefficiency.

We have just shown that in making 1 lb. of cement clinker that it was necessary for the raw material to absorb from the surrounding hot gaseous heating agent:

652.5 B.t.u. *below* 805 deg. C. (1481 deg. F.) and

918.6 B.t.u. *above* 805 deg.C.

So that in order to make 1 lb. of cement clinker 652.5 low grade B.t.u.'s and 918.6 high grade B.t.u.'s are essential.

There is no difficulty in supplying the low grade B.t.u.'s required for cement making. The supply of the high grade B.t.u.'s is, however, a much more difficult matter, as heat is extremely rapidly lost by radiation and convection at temperatures exceeding 805 deg. C. (1481 deg. F.).

The rate at which heat losses by radiation occur increase according to Steffan's law in proportion to the fourth power of the absolute temperature. So that when the temperature becomes very high enormous quantities of heat are lost in this way by radiation from hotter to colder surfaces. If we *double* the absolute temperature we increase the rate at which high grade heat is lost 16 times. If we *treble* the absolute temperature the heat is lost 81 times as fast! So that when temperatures become very high the number of high grade B.t.u.'s lost by radiation at these high temperatures becomes perfectly enormous.

It will be seen, therefore, that the really valuable B.t.u.'s are lost by the gaseous heating medium above 805 deg. C. (1481 deg. F.), which are precisely those liable to be lost by radiation to colder bodies in the neighborhood.

To every 918.6 high grade B.t.u. lost in this way there corresponds the loss of 1 lb. of potential clinker.

Extent of Clinker Losses by External Radiation

When we examine the question of the thermal losses by external radiation from the rotary kiln in the light of this conception, we find that the effect of the external radiation losses are much more serious than has heretofore been believed.

For example, if we measure the percentage of external radiation losses from the rotary kiln, measured on the total number of B.t.u.'s liberated in the kiln by the coal, we find that about an 8% loss occurs.

When, however, we come to work these losses out in terms of high grade and low grade B.t.u.'s we find that a much higher proportion of high grade B.t.u.'s are lost than of low grade, because the bulk of the radiation occurs from the hot, or clinkering, end of the kiln.

Accurate experimental measurements showed that owing to this cause the loss of *clinker formation* due to external radiation amounted to nearly 15%, which is a serious loss.

In other words, in a rotary kiln making 100 tons* of clinker, if we stopped completely all external radiation losses we would make 115 tons* of clinker for the same fuel consumption as before.

Enormous Clinker Losses Due to Internal Radiation

It is, however, when we come to consider the loss of heat by *internal radiation* that this question of losses becomes paramount.

The rotary kiln, it must be remembered, is a tube with one end red hot and the other end comparatively cold. High grade heat is radiated away from the red hot decarbonating and clinkering zones directly into the colder parts of the kiln without doing any useful work. In addition to this, much high grade heat is carried away bodily by the hot gases from the decarbonating zone passing into the colder zones.

Now it is shown that every 918.6 B.t.u. of high grade heat thus passing away into the colder parts of the kiln represents a loss of 1 lb. of potential clinker.

It is proved that if in an ordinary rotary kiln in which we are burning 30 tons* of coal per 100 tons* of clinker made, we suddenly stopped all internal radiation, our output of clinker would rise from 100 to 273 tons,* and if we next stopped all external radiation as well from the kiln, the output of clinker would rise to $273 + 15 = 288$ tons* of clinker. It is assumed here that the entering air is preheated to 400 deg. F. (which is the normal temperature of preheating in a rotary kiln).

SUMMARY

	Coal burnt	Clinker made
The ordinary rotary kiln..	30 tons*	100 tons*
After stopping internal radiation	30 tons*	273 tons*
After stopping internal and external radiation..	30 tons*	288 tons*

Method of Preventing Internal Radiation Losses

It will be seen, therefore, that enormous losses occur inside a rotary kiln owing to internal radiative losses. The question is, how are these losses to be stopped?

In order to attempt the solution of this question it is essential to understand the causes of the great internal radiation losses of the rotary kiln.

Undoubtedly the main cause is the fact that in the rotary kiln there occurs a great volume of empty space, or rather, space filled only by thermally transparent gases. Consequently, high grade heat can freely radiate through these hollow spaces from the hotter to the colder parts of the kiln.

We are helped considerably in seeing how this inherent defect of the rotary kiln may be overcome by considering the case of the shaft kiln. Here internal radiation and convection losses are largely reduced by the device of filling the interior with a mass of coke and raw material briquettes, so that any radiant or convective heat is caused to impinge on a surface and consequently high grade heat cannot pass from hotter to colder places without doing useful work by heating intervening raw material. This fact is at once reflected by the greater thermal efficiency of the shaft kiln. Whereas, by burning 30 tons* of coal in the rotary kiln we only obtain, say 100 tons* of cement; in the shaft kiln for the same amount of fuel we obtain from 150 to 190 tons* of cement clinker. Hence by introducing baffling in the shaft kiln we have increased the clinker output by 50 to 90% for the same amount of heat expended.

Increasing the Efficiency of the Rotary Kiln by Baffling

Now one method of increasing the efficiency of the rotary kiln is by introducing baffles in the manner described in Patent B. P. 264,920 (application date October 27, 1925, accepted January 27, 1929) by the writer and J. Darnley Taylor.

The idea consisted in placing inside the kiln a considerable number of baffles so arranged as to shield the different parts of the kiln from direct radiation losses.

Fig. 1 shows a rotary kiln thus fitted with baffles, these being placed in staggered relationship to each other, whereby the kiln is divided into a plurality of chambers and loss of heat by direct radiation from one part of the kiln to another is largely prevented. Also since in general the gases flowing through a kiln do not intermingle to any great extent with the raw material, but escape at a high temperature, this arrangement is also beneficial in facilitating heating by mutual physical contact—of gas and material —the main method of heating at low temperatures but not at high temperatures, where the main heating is effected by radiation from hot surfaces.

However, by adopting these devices we are brought up against the serious practical difficulties. The valuable effective B.t.u.'s lost by radiation are precisely those evolved at a very high temperature so that the baffling media must be able to withstand not only a white heat but also the heavy pounding action of the clinker passing down the kiln.

Then again the introduction of baffles spoils the draught of a kiln and makes necessary the introduction of fans, etc., at the cold end, preferably attached to waste-heat boilers.

Undoubtedly great improvements are possible in this direction, but the technical difficulties to be overcome are considerable.

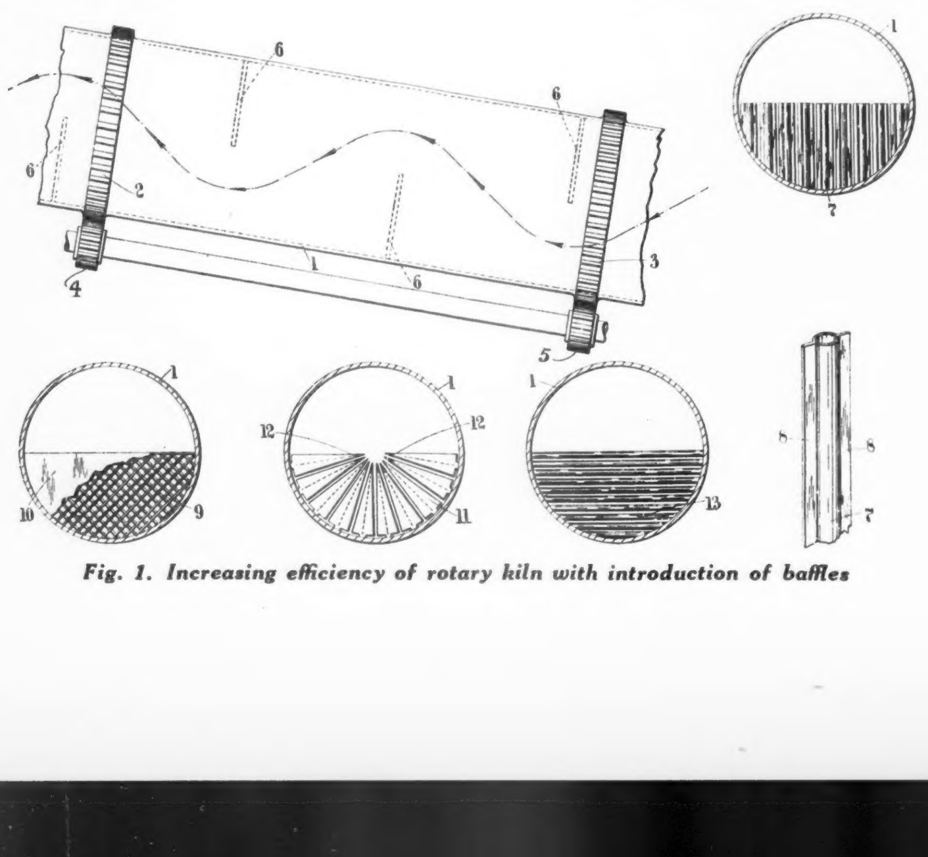


Fig. 1. Increasing efficiency of rotary kiln with introduction of baffles

Baffling Radiant Heat by Means of Dust

Meanwhile attempts to solve the problem along other lines were being made.

Instead of using solid diaphragms to act as baffles at a white heat, why not use the raw material itself in the form of dust? This would stand up to the clinkering temperature itself, and it is well known that finely divided dust presents an enormous surface for arresting radiation. For exam-

ple, accurate experiments carried out by the writer have shown that 1 lb. of quartz sand finely ground in a tube mill presents a surface running from 300 to 2000 sq. ft.‡

It is well known what an effective arrester of radiant energy is formed by a dust cloud or fog. A certain weight of water dispersed in the form of very fine globules will arrest light or radiant energy far more effectively than if this water is condensed into a single transparent mass.

Consequently, filling the interior of a kiln with a mass of raw material reduced to a state of extremely fine division will stop the internal radiation losses going on in the ordinary rotary kiln as effectively as is now achieved in the shaft kiln, by filling up its interior with large blocks of raw material and coke.

Davis's Experiments

Among the first to try practical experiments on a large scale on these lines was Arthur Charles Davis of the British and Associated Portland Cement Co.

His apparatus (British patent specification No. 307,763, application date October 11, 1927; complete accepted, March 11, 1929) is shown in Fig. 2.

The apparatus consisted of a vertical-shaft kiln at the base of which slurry or raw meal is injected as a fine suspension through one or more jets located at or adjacent to the base of the kiln, the injection being vertically up into the kiln through the plane of the combustion zone, so that the material has a passage upwards and downwards through the hot gases.

The velocity at which the slurry is projected into the kiln and its degree of atomization or subdivision may be so arranged that the slurry or other material is kept in suspension by the velocity of the air until its density is increased by calcination to such an extent as to cause the grains to fall to the base of the kiln. The flame temperature could also be adjusted so that in combination with the degree of atomization of the slurry the period occupied in falling through the flame is sufficient to raise the temperature of the material to the clinkering temperature, which is in the neighborhood of 1400 deg. C. (2552 deg. F.). That is to say with coarsely atomized slurry the period for transmission of the heat throughout the particles will be longer, and in such a case the flame temperature must be raised, and vice versa.

Also, the flame may be adjustable so that if necessary a swirling or rotary motion could be given to it to facilitate the heating

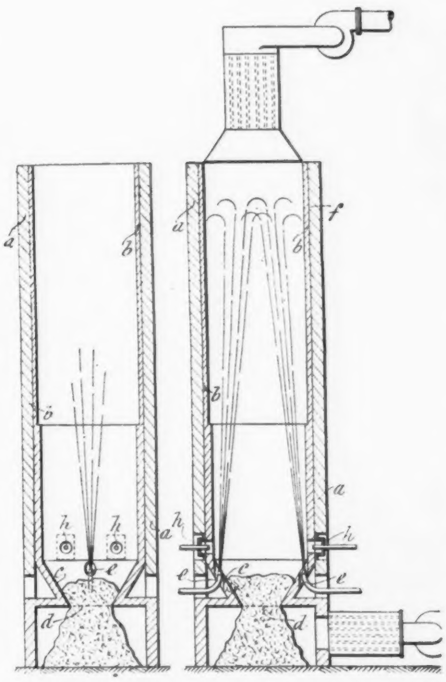


Fig. 2. Filling interior of kiln with raw material to reduce radiation losses

of the material for the required time, such as by arranging the burner so that the path of the projection is tangential to the wall of the kiln. By imparting this swirling motion the flame could be concentrated at the bottom of the kiln.

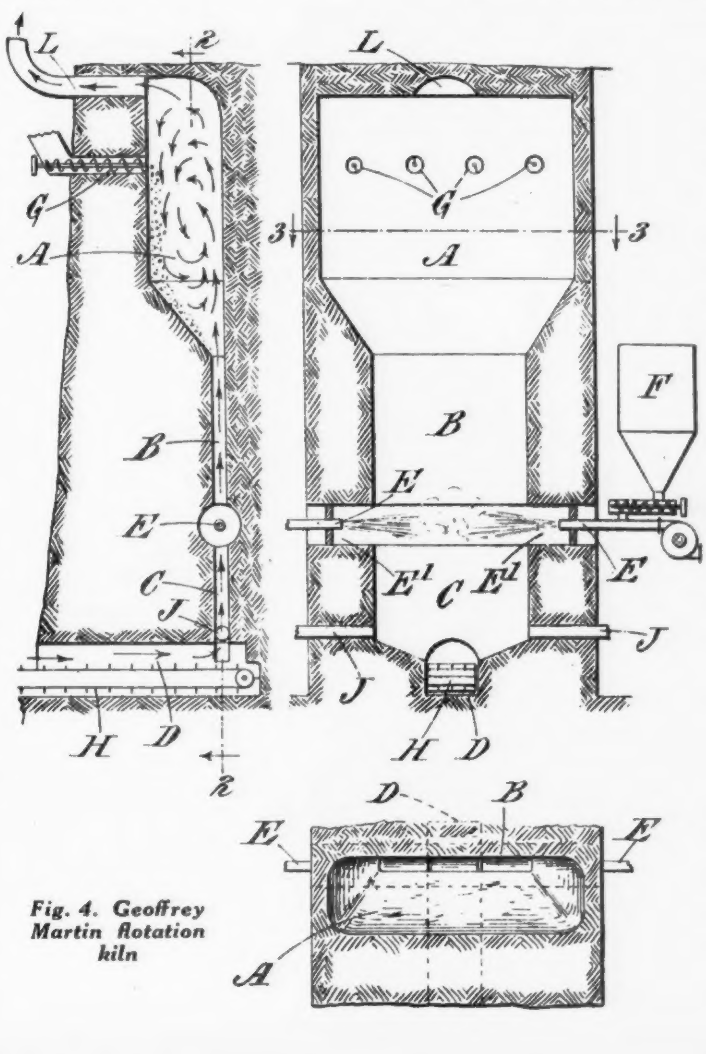


Fig. 4. Geoffrey Martin flotation kiln

Fig. 2 shows the main feature of the kiln. A is the vertical wall of the kiln, C its refractory lining. The lower end of the kiln is tapered at C and is provided with an outlet D for the passage of the clinker. Two jets E for projecting a spray of slurry, raw meal or other cement-forming material are shown located adjacent to the periphery of the kiln, although any suitable number may be employed.

The jets E are adjustable (not shown) as to angle of throw so that the spray peak indicated at F may be adjusted to give the desired length of path (upward or downward) to the slurry through the hot gases.

Four oil, coal or other burners H are provided, located on either side of the slurry or other spray, arranged in pairs opposite one another, a jet being positioned intermediate to each pair such that the spray has a free path at the outset.

It is understood that this apparatus produced excellent clinker in the form of spherical granules.

It obviously suffered from serious technical defects. The fuel consumption must be very high owing to the fact that the radiated heat from the burners impinged too rapidly upon the cold slurry, much high grade heat being lost thereby. Also the spherical granules of clinker adhered together in falling and made the removal of the clinker from the bottom of the kiln difficult. Also the output proved low. In other words, the process was one which (like the rotary kiln) could only be expected to work satisfactory if tried on a very large scale, as in no other way could these defects be eliminated.

It is understood, however, that these experiments are still proceeding and great improvements may be expected. Nevertheless the apparatus is fundamentally faulty inasmuch as the countercurrent principle of thermodynamic efficiency is infringed.

It is a well-known principle of engineering that in order to obtain efficiency it is essential that in any heat interchange the feeding of the raw material should take place in such

‡See the following papers by the writer and his co-workers:

"Researches on the Theory of Fine Grinding," Part III. *Trans. Ceramic Society*, 1925-1926, Vol. XXV; Tests No. 145 to 151.

"Connection Between the Surface Area Produced and the Work Done in Tube-Mill Grinding of Quartz Sand." By Geoffrey Martin, Edgar A. Bowes and F. B. Turner.

"Researches on the Theory of Fine Grinding, Part X; On the Connection Between the Statistical Diameter of Crushed Sand Particles and Their Statistical Surface." *Trans. Ceramic Society*, 1927-28, Vol. XXVII, p. 259 et. seq. By Geoffrey Martin and Edgar A. Bowes.

a manner that only the hottest gases can come into the vicinity of hottest raw material and the coldest gases into contact with the coldest raw material—a principle which is invariably observed in all commercially successful plants, like the rotary kiln and the ordinary shaft kiln, for example, where only the comparatively cold exit gases first touch the cold entering raw material.

To sum up the defects of Davis's kiln:

(1) Low output owing to the impossibility of constructing large enough kilns to make the process economically possible to compete with the rotary kiln process.

(2) High fuel consumption owing to faulty feeding of the cold raw material too near the hot zone whereby the thermodynamical principle of countercurrent heat interchange is infringed.

Sir Percy Girouard's Flotation Kiln

Both of these difficulties were got over in a very ingenious manner by Sir Percy Girouard, who anticipated Davis by a couple of years in the conception of introducing finely divided raw material into a vertical shaft. (B. P. 260,684; application date, August 7, 1925; accepted November 8, 1926.)

Girouard solved the problem of constructing very large kilns in an inexpensive manner in a very simple way, merely by excavating a hole in a limestone hill and lining it with a suitable layer of refractory material and showering down the shaft the dry material in the form of a powder. By this means kilns of the most gigantic size could be rapidly and cheaply constructed, as the stresses in the masonry would be taken up on the rock on the inside of the hill.

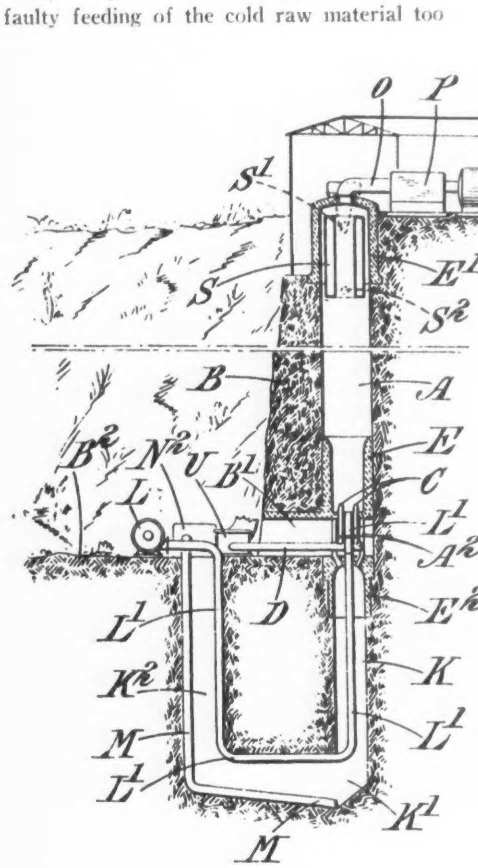
Girouard also introduced his raw material at the top of the kiln in the correct countercurrent manner, the coldest raw material thus coming into contact with the coldest issuing gas, and the gas being finally passed through a waste-heat boiler. Fig. 3 shows Girouard's installation. The vertical kiln shaft *A* is sunk with its longitudinal axis approximately parallel to the face *B* of a quarry, the base of the shaft proper being on the ground level B^2 of the quarry.

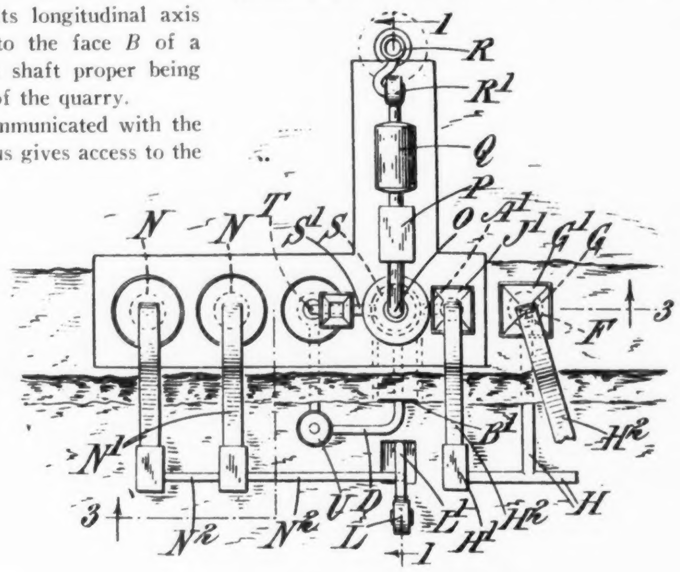
A working adit *B* communicated with the base of the shaft and thus gives access to the burners *C* to which pulverized fuel is supplied through one or more pipes *D*.

The raw material after crushing, drying and storing in a series of bins *F* (which may be excavated in the ground) are transferred by means of conveyors and elevators to a hopper or bin *J*, of a pulverizing apparatus *J*, whereby the materials are introduced into the top of the kiln in the form of a dense cloud of dry pulverized particles.

Around or between the burner nozzles *C* are by-passages A^2 through which the hot clinker passes into a cooling shaft *K* sunk in the ground below the kiln shaft and working adit, whence by means of a series of conveyors and elevators *M* the formed clinker can be removed. The burners *C* are supplied with hot air means of a pipe *L*, which passes through the hot clinker.

Q is a waste-heat boiler, *P* a dust collector and R^1 a fan.





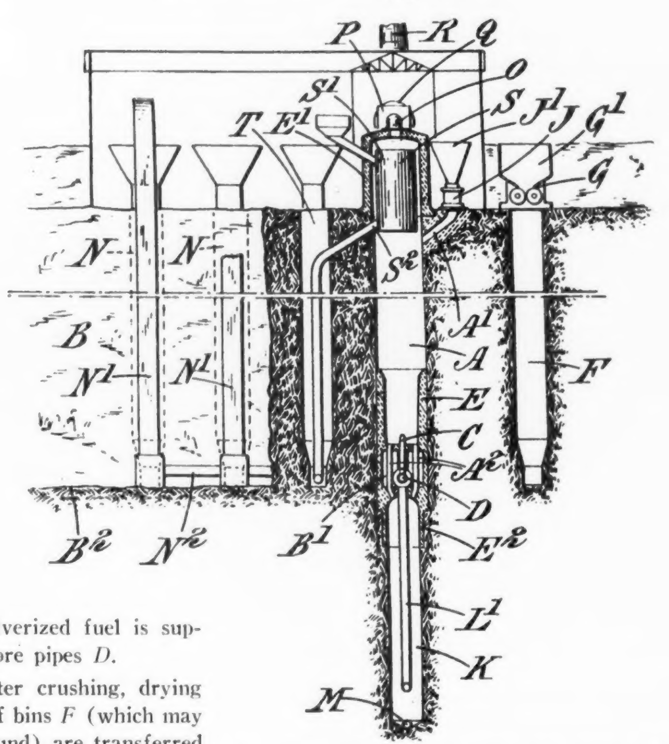


Fig. 3. How Sir Percy Girouard solved problem of constructing large kilns by excavating hole in a limestone hill and lining it with suitable refractory material

Technical Difficulties Due to Escape of Dust—Martin's Researches

Although this apparatus represents a considerable advance on Davis's kiln, there still remained the serious technical difficulties to be overcome of preventing the dust being blown out of the kiln by the upward rush of hot gas.

There is a definite connection between the velocity of the gas and the size of the particle which it will carry out. The connection was worked out by the writer.†

It must be recollected that it is impossible

†See the following papers: "Researches on the Theory of Fine Grinding, Part VI. On the Diameters of Irregularly Shaped Crushed Sand Particles Lifted by Air Currents of Different Speeds and Different Temperatures," by Geoffrey Martin, *Trans. Ceramic Society*, 1926-1927, Vol. XXVI, p. 21.
"Researches on the Laws of Air Elutriation," by Geoffrey Martin, *Trans. of the Institution of Chemical Engineers*, 1926, Vol. 4, p. 164.

to generate cement clinker without generating gas at the same time.

For example in the *wet process* of cement formation to every 1 lb. of clinker produced no less than 5 lb. of gas are generated, which occupy 167 cu. ft. of space at an exit temperature of 800 deg. F., while in the dry process about half this weight of gas is generated, which at an exit temperature of 1350 deg. F. occupies about 100 cu. ft.

It is obvious, therefore, that if a large output of clinker is aimed at there will be a vast volume of gas rushing out of the kiln at a great speed. In the ordinary rotary kiln the gas leaves the kiln at a speed of about 16 ft. per sec.

Such an outrush of gas will carry with it great volumes of dust, and indeed prevent the entry of fine dust into the kiln at all, as it will be blown out faster than it enters. It also renders the output of the kiln small. The particles must descend against a stream of ascending hot gas, and consequently the particles must be of the correct size. A great deal of research work was carried out by the writer with a view to deciding the correct weight and size of the particles to introduce. If the particles are too small they will float away as smoke, and if too large, they will fall too rapidly down the kiln and probably will emerge as underburnt clinker. The correct limits of size, with due allowance for viscosity of the hot air, were worked out, and the writer succeeded in completely overcoming these difficulties by introducing a cyclonic action in the upper part of the kiln as described in B. P. No. 276,066 (application date May 17, 1926; complete acceptance August 17, 1927).

The Geoffrey Martin Flotation Kiln

The following is a description of the kiln. (The kiln was sunk in the ground.) The cyclonic action was induced in the upper part of the kiln by making it considerably wider than the lower clinkering zone and so arranged that the hot gas from the clinkering zone impinges at a high speed upon the mass of gas in the upper zone tangentially along one side as indicated in Fig. 4 on page 63.

The effect of this arrangement is that the stream of hot gas rushing up the clinkering zone impinges eccentrically upon a slower moving stream of colder gas in the calcining zone, with the result that a rotary movement is set up in the larger volume of gas in the calcining zone, which results in a downward movement of gas on the colder side of the kiln remote from the clinkering zone and an upward movement of gas on the hotter side of the kiln closer to the clinkering zone.

Also the introduction of pulverized raw material is arranged to take place in such a manner that it is in the *same* direction as the downward gaseous current. This is achieved by introducing the cold raw material at the side of the shaft—as shown in the figure. This causes the kiln to be cooler on one side than on the other, with the result that a circulatory and downward movement of the hot gas takes place from the hotter side of the kiln to the colder side, which sweeps the finer particles downwards towards the hotter parts of the kiln, where becoming incandescent they sinter or fuse together into larger particles and thus are not swept out of the kiln.

In order to accentuate still further this circulatory and downward movement of gas at the point of entry of the raw material into the shaft, the exit gas is drawn off from a point on the same side as the side on which the raw material enters, but above it.

The exit gases are passed through a waste-heat boiler by suction from a fan.

In effect by this arrangement the upper part of the kiln is made to act like a gigantic cyclonic dust collector, only a negligible amount of microscopically fine dust escaping through the waste-heat boiler into the chimney.

Problem of Obtaining a Large Output From a Dust or Flotation Kiln

In the early part of this article it was pointed out that a cement kiln, in order to be commercially successful, must (1) be thermally efficient and (2) must possess a large output.

Of the two conditions probably the second is the more important commercially.

It has also been pointed out that the output of clinker from a cement kiln is proportional to the volume of gas pouring through it, as the production of each pound of clinker is necessarily attended with the production of a definite volume of gas. Any furnace in which the gas cannot freely flow through will necessarily have a small output and vice versa.

For example, gas is impeded from passing through an ordinary shaft kiln because its interior is filled with solid blocks or bri-

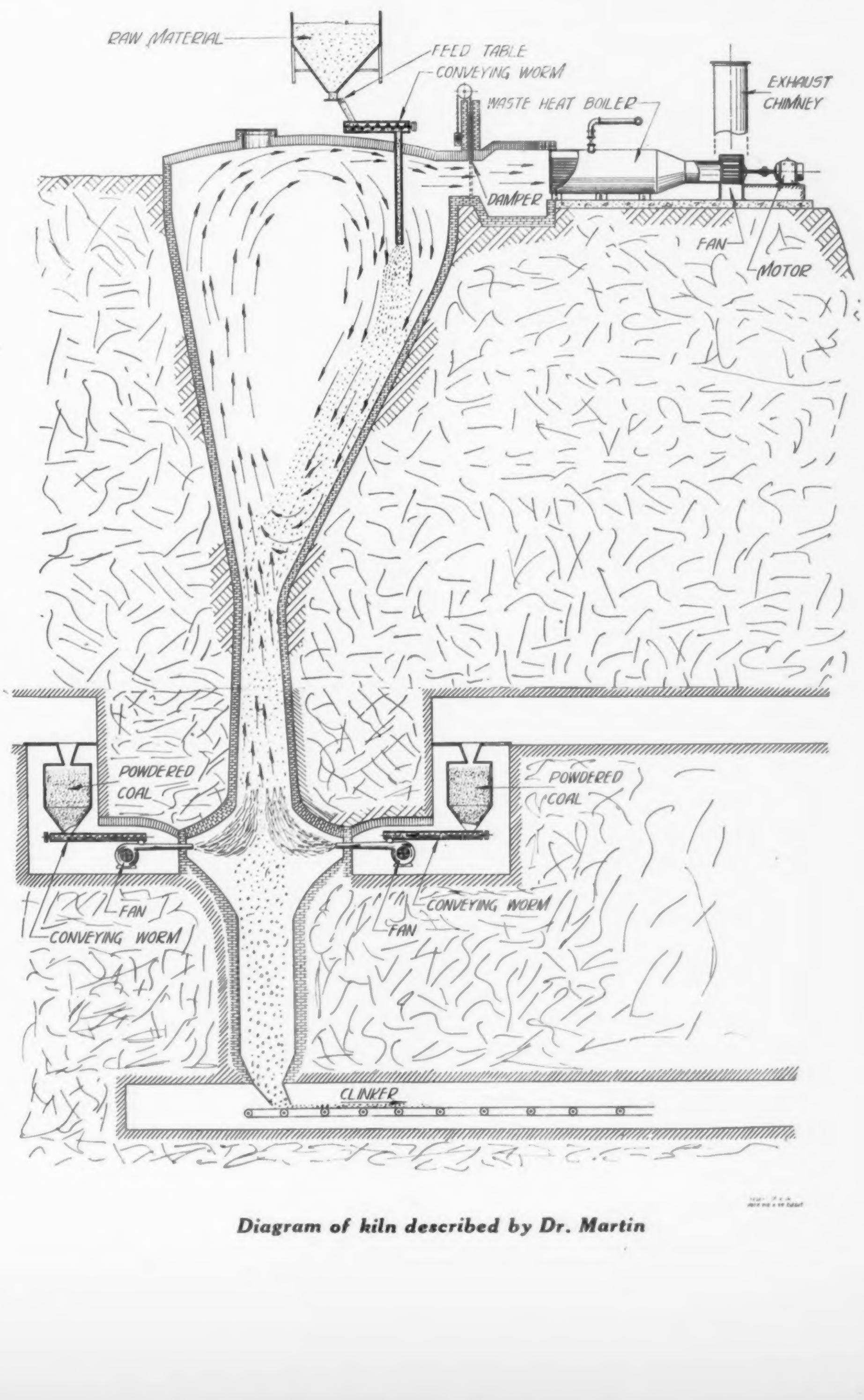
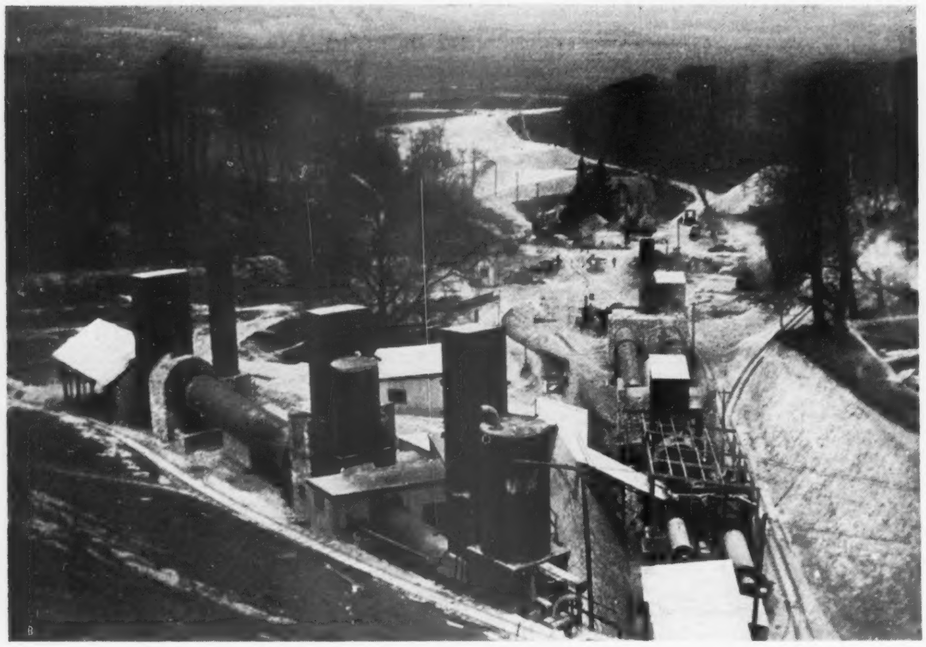


Diagram of kiln described by Dr. Martin



Coal pulverizing plant and raw material dryers at Asheham

quettes, and the combustion gas has to pass between their interstices, thus exposing the gases to great friction in their tortuous passage.

Therefore, the output from a shaft kiln is low, for only a small amount of gas can traverse it in a given time. On the other hand gas can freely pour through a rotary kiln and this is why its output is so large.

Now in the case of a kiln of the present type gas can freely traverse it because of the smallness and consequent mobility of the particles filling it—the dimensions of the particles being carefully confined so as to cause them to fall in the ascending flue gas at the same speed as they are uplifted, i.e., the terminal speed or fall of the particles is made equal to the speed of the gases traversing the kiln. The particles thus *float* in the ascending gases and do not impede the flow of the latter through the kiln. Consequently a great volume of hot gas may be made to traverse the flotation kiln in a given time, and therefore as great an output of clinker is attainable in the flotation kiln as in the rotary kiln, and for the same reason, the ease with which hot gases can traverse both types of kiln.

In fact this flotation kiln may be regarded as a particular case of a shaft kiln in which the preheating and calcining zones are filled, not with the usual large blocks of material to be burnt mixed with fuel, but with small particles of raw material of such a size that they are easily lifted by an uprising gaseous velocity of 4 ft. per sec., but sink in a gaseous velocity of one inch or less per second, so that the contents of the calcining zone form a coarse powder which is maintained in a state of agitation and is heated by hot gases of combustion traversing it; and this powder does not materially impede the progress of the gases through it since the particles are being continually swept out of the way by the ascending volumes of gas. Hence, as large volumes of gases can pass in a given time, a large output of clinker in a given time is conditioned by the volume of gas which can escape in this given unit of time.

Improved Mixing of Raw Materials in Flotation Kiln

As is well known, a frequent cause of unsoundness in finished cement is inefficient mixing of the raw materials before entering the furnace. In fact this is the main reason why cement manufacturers prefer to add water to the raw materials in order to make them into a thin mud (in spite of the fact that all this water must be later evaporated again and consume fuel thereby). Now in the ordinary wet process of cement manufacture this mixing is achieved by grinding the materials when suspended in the fluid water, since mixing when suspended in a fluid is always much more perfect than when the materials are mixed dry.

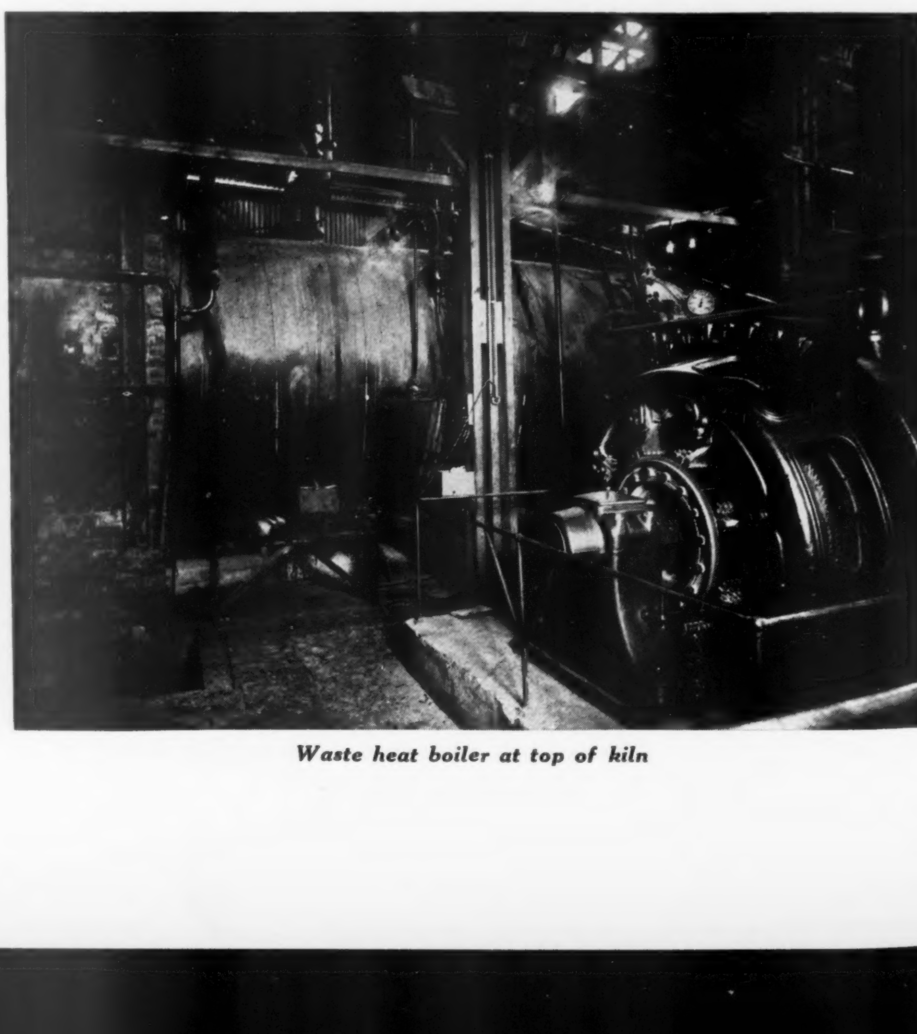
In the flotation-kiln process this mixing is effected by mixing the powder in the fluid gases of the kiln itself, in the upper cyclone portion of the kiln, whereby a much more perfect mixture is achieved, and when the mixing is completed the gases pass away themselves without the necessity of burning extra fuel to distill them away, as occurs when water is used as the mixing fluid.

The mixing occurs in the decarbonating and preheating part of the kiln, the particles being whirled around by the circulating currents of hot gas in these zones until complete admixture is effected before they can pass into the clinkering zones. This process of mixing without the aid of water by using a thin fluid-like hot gas represents a considerable technical advance.

Other Advantages of the Flotation Kiln

A continuous process, where possible, is almost always much more economical than a discontinuous process, especially as regards furnaces, where masses of brickwork must be heated.

In this respect the flotation process kiln is like the rotary kiln, quite continuous in operation. The raw material in the form of a powder is fed in at the top of the kiln, and continuously issues as clinker at the bottom end. The process goes on continuously night and day, so long as the supply of raw material is kept up and the fuel is kept burning in the burners.



Waste heat boiler at top of kiln

Top of the furnace in course of erection during Asheham experiment

The flotation kiln possesses advantage over the rotary kiln in that there are no moving parts to get out of order. In a rotary kiln a great mass of iron and brickwork, weighing many hundreds of tons, must be kept moving continuously, supported on massive steel rollers. In the flotation kiln all these disadvantages disappear because the kiln itself is stationary, and it is simply the action of gravity which pulls the material down and through the kiln. Moreover, in the rotary kiln the rotation of the brickwork causes the formation of clinker rings, which occasion periodical losses and stoppages. In the flotation kiln all such movements are absent as would cause the formation of clinker rings, so that such a kiln may be expected to run continuously without any interruptions for months at a time. The action of the linings also must for similar reasons be reduced to a minimum.

Erection of a Large Flotation Kiln at Asheham, Near Lewes, Sussex, England

In order to test out the advantages of a flotation kiln over a rotary kiln, and the possibility of manufacturing clinker on a large scale, a large scale experiment was carried out at Asheham by a group of financiers, among whom may be mentioned Charles F. Lumb, Sir Percy Girouard, Mr. Hamilton and S. R. Worley, all of London.

The kiln was built by the writer, being about 150 ft. deep and possessing an area of about 800 sq. ft. at the top. It was fitted with a waste-heat boiler at the top.

A diagrammatic view of the kiln is shown in Fig. 5. Photographs of the works are also shown.

A series of trials carried out during December, 1929, showed most promising results. It is hoped, after making certain alterations, to remedy technical defects which revealed themselves in the trials, to proceed to manufacture clinker by this new process in the near future.

New York State Crushed Stone Association Holds Meeting in Buffalo

A MEETING OF THE NEW YORK State Crushed Stone Association was held at the Meadowbrook Country Club, Buffalo, N. Y., June 27, 1930. With an attendance of twenty-five, including eighteen operators, an interesting session was had, John H. Odenbach, president and A. S. Owens, secretary, presiding. Arrangements for the meeting were made by Messrs. Hooker and Savage of the Buffalo Crushed Stone Co.

The matter of a credit plan, as proposed at a previous meeting by the New York State Highway Chapter of the Associated General Contractors of America, was discussed further, and also the need for a more careful inspection and check-up on the aggregates being used in road work.

On the credit bureau plan suggested by the contractors, a resolution was passed to the effect that the association could not at present see its way clear to join in with the contractors on their proposed plan, but expressing their desire to co-operate in all other matters in which they can be mutually helpful. Geo. E. Schaefer and F. C. Owens were appointed a committee to confer with the contractors' association.

E. N. Deitler of the National Credit Association, New York City, outlined a tentative proposal for the formation of a road building materials and equipment division of the Credit Association, for the interchange of credit information to the material producers. This was discussed but no definite action taken, although as a first step toward more complete credit information a resolution was passed that it was the sense of the meeting that all members should join the National Credit Association for the obtaining of credit reports, the matter of having a separate interchange division or organization to be taken up later.

At the invitation of Mr. Odenbach it was decided to hold the next meeting at Rochester the first week in August.

REGISTRATION

Producers

Buffalo Crushed Stone Co., Buffalo, N. Y. A. J. Hooker, James Savage, Arthur Savage.

Dolomite Products Co., Rochester, N. Y. Harvey N. Clark, John H. Odenbach, Walter Sickles.

Eastern Rock Products, Inc., Utica, N. Y. Albert S. Owens.

General Crushed Stone Co., Syracuse, N. Y. F. C Owens, George E. Schaefer, A. G. Seitz, A. L. Scott, W. L. Sporborg.

Gouverneur Limestone Co., Gouverneur, N. Y. H. H. Hodgkin.

LeRoy Lime and Stone Co., Le Roy, N. Y. J. L. Heimlich, D. E. Moores, D. L. Moores.

Solvay Sales Corp., Syracuse, N. Y. J. H. Kaiser.

Wickwire Spencer Steel Co., Gasport, N. Y. W. E. Foote.

Others

William Anderson, Hercules Powder Co., Buffalo, N. Y.; M. D. Caldwell, Atlas Powder Co., Rochester, N. Y.; Herbert Conley, Union Explosives Co., Le Roy, N. Y.; E. N. Deitler, National Credit Association, New York City; Norman Eggers, Utica Credit Association, Utica, N. Y.; H. C. Farrell, Buffalo Credit Association, Buffalo, N. Y.; E. C. Harsh, ROCK PRODUCTS, Chicago, Ill.

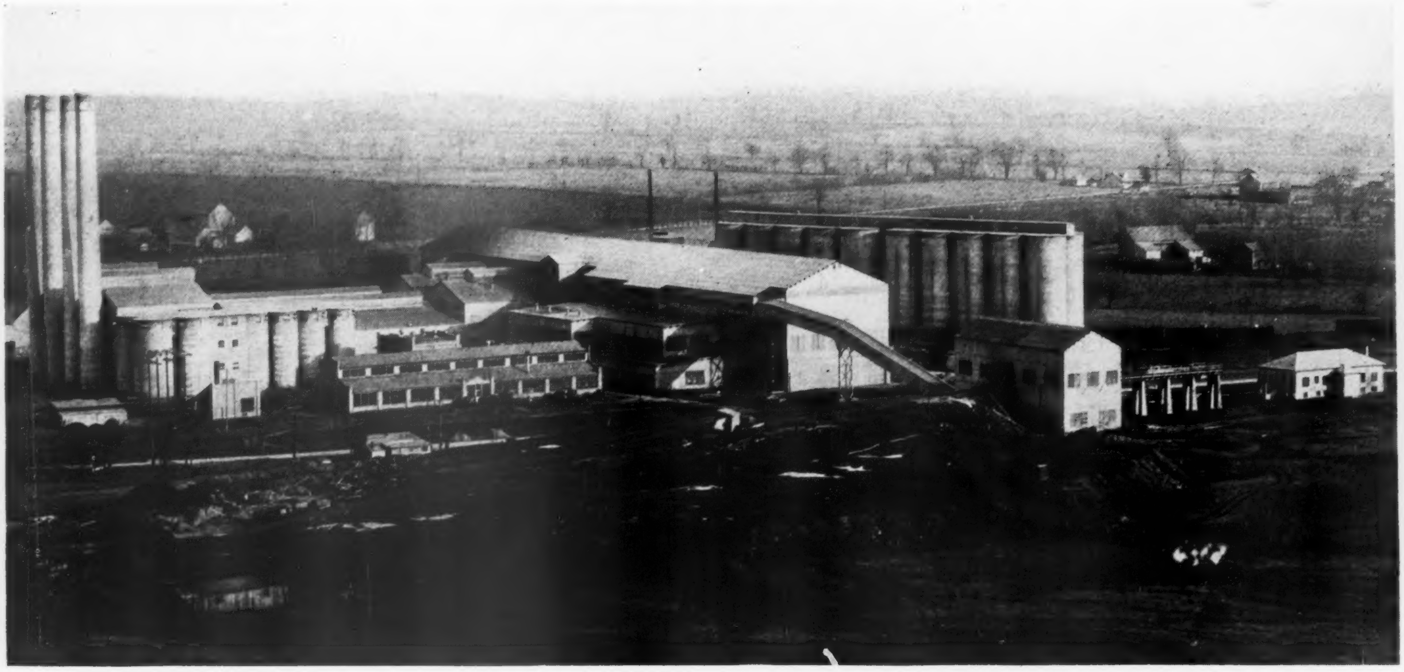
Agricultural Limestone Meet

THE NATIONAL AGRICULTURAL Limestone Association held its annual meeting at Buffalo, June 26, 1930. N. G. Farber, Michigan Limestone and Chemical Co., Buffalo, is president, and Scott Wuichet, Mohawk Limestone Products Co., Mohawk, N. Y., secretary. Members were present from New York, Pennsylvania and Ohio.

Clay Producers to Organize

IN THE EFFORT to formulate plans for a clay manufacturers' association, a meeting of producers will be held on Wednesday, July 16, at 10:30 a. m., in the New York Athletic Club, New York City, according to an announcement from W. J. Parker, commissioner of the Feldspar Grinders' Institute, Inc.

Considerable interest in such an association has been manifest since the Feldspar producers organized in 1929 and undoubtedly the clay association will be patterned after the Feldspar Institute. For further information communicate with Mr. Parker at 7 East 44th Street, New York City.



A recent aeroplane view of the Keystone Portland Cement Co., Bath, Penn. The new office can be seen at the extreme right. Close by is the crusher plant, which has been enlarged

Slugger-Roll Crusher for Primary Breaker of Hard Rock

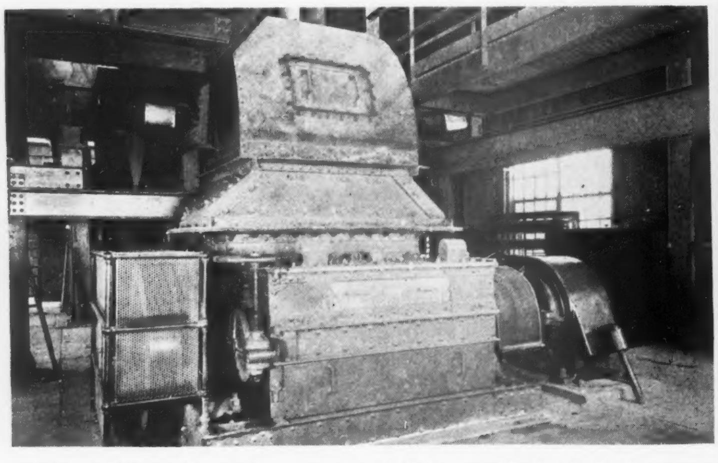
Keystone Portland Cement Co., Bath, Penn., Said to Have Largest Installation in the World

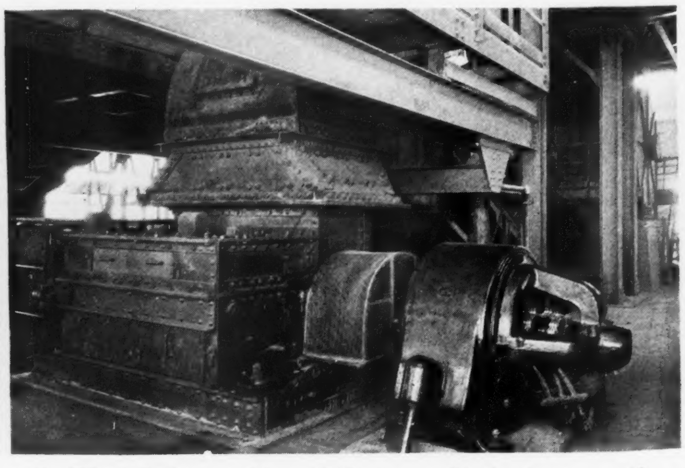
IN THE October 13, 1928, issue of ROCK PRODUCTS was published a description of the then new plant of the Keystone Portland Cement Co., at Bath, Penn., in the Lehigh Valley. The plant at that time was unusual, embodying several features that deviated from regular American portland cement practice. All of the equipment was supplied by Polysius Corp., and at that time this was the first installation of its kind in the United States, using equipment the design of which originated in Europe.

The plant at that time was described as a model of engineering efficiency and one capable of producing a high quality product with low fuel and labor costs. These features are still maintained. The plant is still a model for many other portland cement producers to follow if neatness and orderly appearance are the issue.

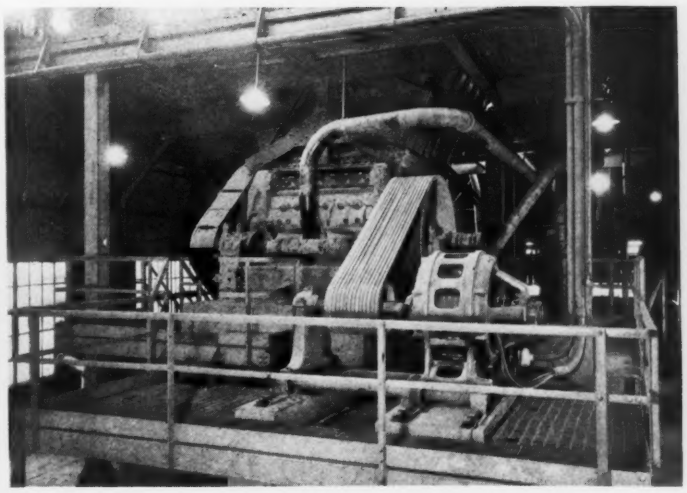
Since the original installation was started late in 1928, two additional Polysius kilns have been installed as well as additional Solo grinding equipment, similar to the original, to take care of the new kiln's requirements. The kilns are said to be very efficient when fuel consumption is considered, giving a fuel efficiency considerably above the average kiln of similar size and capacity. The plant uses the wet process.

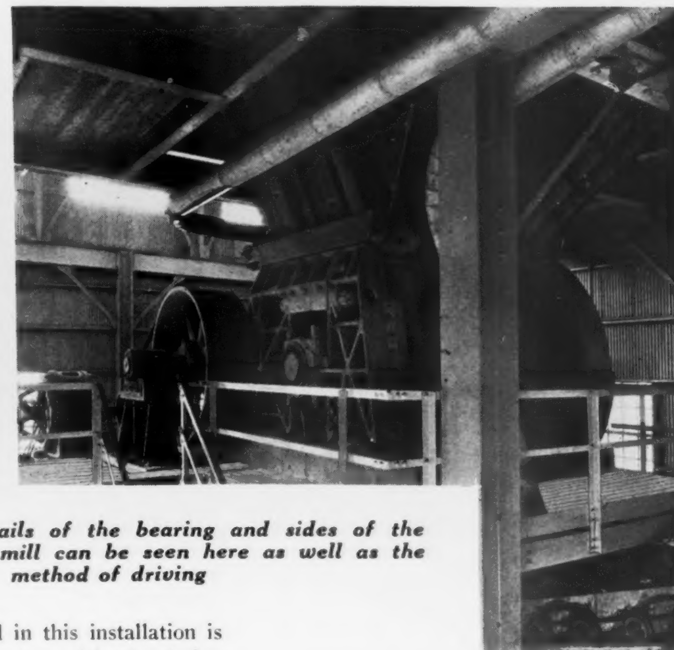
Nineteen new silos and three star bins were completed about May 15 of this year for storage of finished cement. The new con-





These views show the motor and drive method of the hammer mill. The relative position of the two mills is shown, as the primary roll crusher can be seen in the background of the illustration at right





Construction details of the bearing and sides of the primary slugger mill can be seen here as well as the method of driving

struction gave a total added storage capacity of 165,000 bbl. The new silos are filled by Fuller-Kinyon pumps and are emptied by screw conveyors that deliver to additional new packhouses. The construction work was done by the Rust Engineering Co., Pittsburgh, Penn.

New Crushing Installation

Perhaps the most interesting changes in this plant are in the primary and secondary crushing plant, for the equipment installed for the crushing is not only of an unusual type, but is of such a large size that this crushing unit is said to be the largest of its kind in the world.

Owing to the slabby nature of the cement rock in the Lehigh Valley the conventional jaw or gyratory crusher does not completely solve the problems incidental to primary crushing. The high silica content of the stone is a factor that must be considered, for it is of a very abrasive nature and requires crusher or roll wearing parts of surface hardness to withstand severe wear. Some of the limestone in the quarry referred to as high silica has 13% SiO_2 and 7.75% R_2O_3. The higher calcium limestone will run 6.75% SiO_2 and 5.0% R_2O_3.

The Keystone Portland Cement Co. last year replaced the original crusher with a Penn-Lehigh, primary, single-roll crusher of the Pennsylvania Crusher Co. Before this crusher was installed, the quarry and crushing plant were operated at sufficient capacity to put 70,000 tons of crushed cement rock in storage, so that the plant's regular cement shipments would not be jeopardized.

Only a few alterations were necessary to install the Penn-Lehigh mill, for the new unit rests on the foundations previously supporting the original crusher. The feed hopper is also practically the same as on the previous installation. The building itself was extended slightly in length to accommodate a 30-ft. center to center 42-in. pan conveyor, that delivers the crusher discharge from the primary crusher to the Super-Thor, size SXT-14 Pennsylvania hammer mill that acts as a secondary crusher.

The primary roll crusher is of the single-roll, slugger type, and in this installation is considered to be the last word in the design of a crusher of this type. The side frames have been strengthened and simplified in construction so that the bearings or other wearing parts can be gotten at with a minimum of trouble. The stationary breaker plate is protected by a new type of coupling that acts as a shear pin and will protect the unit from breakage due to tramp iron. The design is massive throughout and gives the impression of brute strength which it undoubtedly possesses.

Due to the massiveness of the construction of these two crushing units, there is a minimum of vibration at either the Penn-Lehigh rolls or the hammer mill.

From time to time the lugs on the slugger are built up with Stellite, and it was said that by this treatment the life of the lugs was increased greatly. At the time of inspection, the lugs on the roll in use had crushed 500,000 tons without excessive wear.

The crusher receives the biggest stones that the quarry produces, some of which are 4 ft. long and 2 ft. thick, and reduces them to 6 in. sizes at the rate of 400 tons per hour. This smaller size is fed to the Pennsylvania hammer mill and reduced to 1¼-in. size after which the cement rock is conveyed to storage.

The primary slugger roll is driven by a 300-hp. type C. S. Westinghouse induction motor, 2200 volts, 704 r.p.m. through a Westinghouse Cogbelt drive. The mill operates at 180 r.p.m

The hammer mill is direct-connected to a 500-hp., General Electric, 2200-volt induction motor and operates at 710 r.p.m. The pan conveyor serving the secondary hammer mill was supplied by Polysius Corp., and is driven through a gear reduction unit by a 10-hp. motor.

Both mills are connected with light metal pipes that convey the dust to a battery of five Norblo dust collectors, making the operation practically dustless.

A new office has been built at the plant which, with the landscaping that has been done around it, gives a very favorable impression. John Barnes of Philadelphia is president and Howard Leh is general manager of the Keystone Portland Cement Co. Willis Altemus is superintendent.

New California Aggregate Plant in Operation

THE RENSHAW SAND, ROCK AND GRAVEL CO., Alturas, Calif., began operations recently with a crushing and washing plant which recently has been erected a mile east of the city limits on the Cedarville highway.

The company has been in operation here for the past year and a half, and the new plant has been completed near the city to supply local demand for sand and gravel for building and street purposes. The crusher, which is located west of the city, will continue in operation, supplying a hard crushed rock.

The new plant is under the direction of E. Moyer, plant superintendent, who has been in charge of the construction. Mr. Moyer has been engaged in this work for a number of years, and the present plant built under his specifications is one of the most complete in this part of the state. From the pit to the trucks all operations are automatic, and the product, completely washed under a large head of water, consists of two grades of sand and three sizes of gravel and rock.

Additional construction at the plant includes casings for the belts and an engine house which will be built in the near future.

L. G. Renshaw, owner of the concern, announced recently that the plant will be kept in continuous operation during the entire year if building conditions and other construction in the city keep the demand for materials at the present level.—*Alturas* (Calif.) *Times*.

Gypsum and Gypsum Products Manufacture—Part I

Raw Gypsum, Composition, Properties, Impurities; Decomposition; Calcined Gypsum; Processes; Control; Products

By S. G. McAnally

Chief Chemist, Giant Portland Cement Co., Egypt, Penn.; formerly Chemist for the Pacific Portland Cement Co., Mound House, Nev., and Chemist and Superintendent for the Standard Gypsum Co., Ludwig, Nev.

THE MINERAL GYPSUM is hydrated calcium sulphate. Lacking definite knowledge of the true structure of the gypsum molecule, its chemical formula is generally given as $CaSO_4 \cdot 2H_2O$. Pure gypsum contains 79.1% calcium sulphate and 20.9% water.

Gypsum occurs in several forms; rock or massive, in which the crystals are small; coarse crystalline (selenite); fibrous (satin spar); gypsum sands, and gypsite, which is a fine earth. Gypsum is comparatively soft and can be slightly scratched by the thumb nail; it is soluble in hydrochloric acid without effervescence. These tests distinguish it readily from the various forms of limestone and dolomite.

The color of gypsum may be white, grey, bluish, pink, buff, reddish-brown or even black, depending on the nature of the impurities it contains. Gypsum is seldom found in the pure state, but is usually associated with one or more of the following minerals or compounds: limestone, anhydrite, iron pyrites, silicious material, copper and magnesium sulphates, sodium chloride, etc. Pockets of coal have been found in beds of gypsum. Following is the analysis of the coal from one of these pockets:

Volatile matter	44.25%
Fixed carbon	38.75%
Ash	17.00%

A rather unusual sample of gypsum found in Nevada analyzed as follows:

Gypsum ($CaSO_4 \cdot 2H_2O$)	67.54%
Magnesium sulphate	16.76%
Silica	6.62%
Iron oxide and alumina	3.24%
Sulphuric acid	6.32%

The above material had a very strong acid reaction.

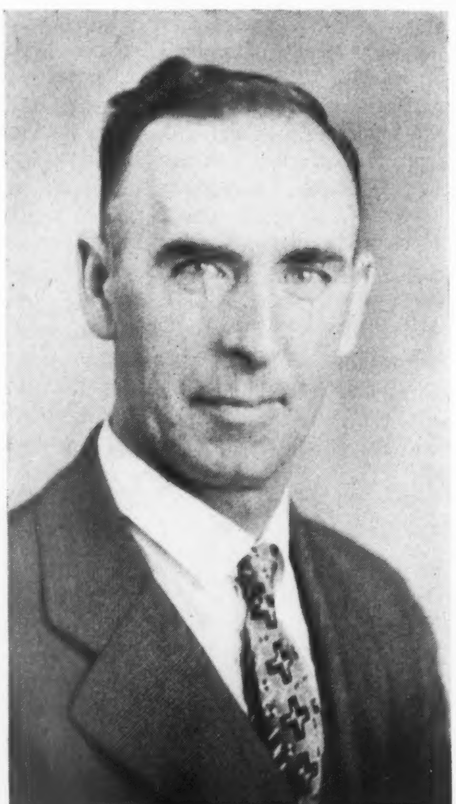
In some gypsum deposits free sulphur can be easily seen and can be detached from the rock in comparatively large pieces.

The chief uses of gypsum are for the manufacture of plasters, for fertilizer, and as a retarder for portland cement.

If gypsum is heated to 130 deg. F., it begins to lose its combined water, and, if the material is kept at this temperature until its weight is constant, it will lose about 75% of its combined water. The minimum temperature at which gypsum begins to decompose has been stated variously by different technologists. In all cases (there may be exceptions) the temperatures given have been higher than 130 deg. F. The following series of tests should be interesting.

Original Experiments to Determine Dissociation Temperature

The experiments were made in Nevada, where the elevation was approximately 4500 ft. above sea level. This may have had some influence on the dissociation temperature, but not more than a few degrees. The tests were made on gypsums of different form, purity, and ground to different finenesses. An electric oven, equipped with a thermostatic control, was used for heating the samples. No difficulty was experienced in maintaining a uniform temperature in the oven. The temperature was checked day and night over the whole period.



S. G. McAnally

The samples were placed on the middle shelf of the oven, and the mercury thermometer bulb almost touched the surface of the sample. Weighings were made at the periods shown in the tabulated results, and the weighed samples returned to the oven. The first test was made for the purpose of determining the progression of the dehydration at 130 deg. F. The time required for the completion of the action was necessarily made longer due to the numerous coolings and reweighings of the sample.

TABLE I—DECOMPOSITION AT 130 DEG. F.

Analysis of rock gypsum: Water, 18.37%; $CaSO_4 \cdot 2H_2O$, 87.81%; fineness, not determined, passing 200-mesh. Size of sample was 16 grams.

Period	% loss of total weight
2 hours	0.012
6 hours	0.021
1 day	2.22
2 days	5.09
3 days	6.00
4 days	8.89
5 days	10.45
6 days	11.52
7 days	12.13
8 days	12.68
9 days	13.00
11 days	13.36
15 days	13.36
19 days	13.56
22 days	13.56

Total percentage loss of the combined water in gypsum..73.8%
H_2O in sample "dried" 24 days 5.56%
Theoretical H_2O in hemi-hydrate from above gypsum.. 5.33%
Sample mixed with water set hard in 4 minutes.

NOTE—In calculating the theoretical combined water in the hemi-hydrate made from a gypsum containing a given percentage of combined water, it must be remembered that, although one-fourth of the water remains in the hemi-hydrate, the quantity of the latter formed is less than the original quantity of gypsum due to the loss of three-fourths of the combined water in the gypsum; this must be taken into consideration when making the calculation; e.g., 100 grams of gypsum containing 20% combined water loses 15% water and produces 85 *grams* of hemi-hydrate containing 5 *grams* of water. Therefore, the hemi-hydrate will contain 5.88% combined water.

The following formula will be useful for calculating the percentage of water in the

hemi-hydrate made from a gypsum of a given composition.

$$\text{Percentage water in hemi-hydrate} = \frac{100\,T}{400-3T}$$

where T equals per cent water in gypsum.

In the succeeding experiments the samples were allowed to remain for a longer period in the oven before weighing.

TABLE II—DECOMPOSITION OF GYPSUM AT 130 DEG. F.

Analysis of gypsum: Water, 18.45%; $CaSO_4 \cdot 2H_2O$, 88.19%; fineness, 96% passing 200-mesh.

Period	% loss of total weight
14 days	13.58
26 days	13.63
30 days	13.68
33 days	13.68

Total loss of combined water..74.1%
H_2O in sample "dried" for 33 days 5.53%
Theoretical H_2O in the hemi-hydrate 5.36%

TABLE III—DECOMPOSITION OF GYPSUM AT 130 DEG. F.

Analysis of gypsum: 18.75% H_2O, 89.63% $CaSO_4 \cdot 2H_2O$, fineness, 45.0% passing 200-mesh.

Period	% loss of total weight
14 days	13.15
30 days	13.65
41 days	13.70
50 days	13.72
63 days	13.70
84 days	13.67
102 days	13.75

Total loss combined water......73.3%
H_2O in sample "dried" for 102 days 5.90%
Theoretical H_2O in hemi-hydrate 5.45%

TABLE IV—DECOMPOSITION OF SELENITE AT 130 DEG. F.

Analysis of selenite: 20.73% H_2O, 99.09% $CaSO_4 \cdot 2H_2O$, fineness, 100% passing 200-mesh.

Period	% loss of total weight
14 days	15.16
17 days	15.25
24 days	15.25
31 days	15.27
38 days	15.30

Total loss of combined water..73.6%
H_2O in sample "dried" for 38 days 6.41%
Theoretical H_2O in hemi-hydrate 6.14%

Fig. 1 shows the decomposition rate of gypsum at 130 deg. F.

A sample of gypsum dried for 2 hours at 140 deg. F. contained 18.33% water. It was then dried for an additional 2 hours at 165 deg. F. and analyzed 14.95% water.

Those interested in the drying of samples of gypsum can arrive at a safe temperature and time limit based on the above results.

It is evident that the combined water in gypsum is very loosely held. The writer conceived the idea of making plaster by mixing gypsum and quick-lime and heating the mixture just sufficiently to start dehydration of the gypsum. The water liberated combines with the lime, forming lime hydrate. The heat given off when the lime hydrates hastens the dehydration of the gypsum.

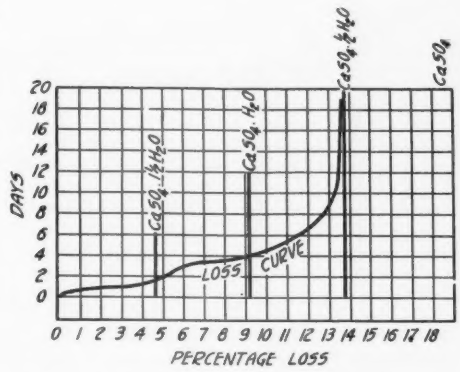


Fig. 1. Decomposition rate of gypsum at low temperatures

sum. Correctly proportioned mixtures will generate sufficient heat to raise the temperature of the mixing 200 deg. F. *above* the initial reacting temperature and produce a plaster of good quality containing calcined gypsum and hydrated lime. A patent has been applied for to cover this process.

In the manufacture of calcined gypsum by the kettle process, the product corresponding to the hemi-hydrate is produced at approximately 300 deg. F. However, it is customary and safer to calcine to a minimum of 340 deg. F. If the calcination is continued until the temperature exceeds 500 deg. F., the gypsum is completely dehydrated. According to some authorities, dead-burned gypsum is produced at the latter temperature. Keene's cement is burned to temperatures in excess of 1000 deg. F., although it has been produced at much lower temperatures. Various types of calciners have been described in ROCK PRODUCTS.

The rotary and the kettle process are those chiefly used for the manufacture of gypsum plasters. This article is mainly concerned with the latter.

Preparation of the Material

The crushed gypsum, 1-in. and under, with or without drying (depending on climatic conditions), is fed to some type of pulverizer. Formerly, burr stones were the only type used, but they have been almost entirely replaced by units which deliver a much finer product to the kettle. For some purposes a coarsely ground kettle feed may

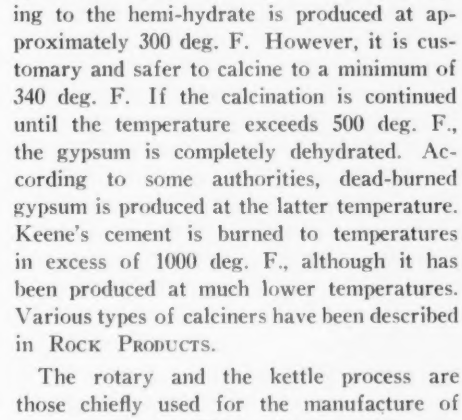


Fig. 2. Temperature curve of a calcination, also boiling action

have advantages, but in order to produce plaster having greater plasticity and the maximum sand carrying capacity, it is essential that the *raw gypsum* be ground to a fineness of not less than 90% passing the 100-mesh. Regrinding of a coarsely ground plaster to the above degree of fineness will not produce the same results. The effects of regrinding will be discussed later.

Coarse grinding of raw gypsum prior to calcination produces denser and stronger plaster, but greater density and strength than that obtained by coarse grinding of the raw gypsum or by higher calcining temperatures (not complete dehydration) can be obtained by aging "single-boil" (first-settle) stucco.

The products of the kettle process are referred to as "single-boil" or "first-settle," "double-boil" or "second-settle." These names are more or less descriptive of the action of the mass of gypsum in the kettle during calcination. The following description of the behavior of the material during calcination is based on observations and actual measurements.

In Fig. 2 *AB* represents the temperature curve of a calcination from the time the kettle is being loaded until it is dumped at 415 deg. F. In this particular case the calcining period is assumed to be 4 hours.

If the kettle has been loaded carefully, the mass of gypsum in the kettle will boil vigorously and give off much steam until the temperature reaches 255-260 deg. At this point the temperature begins to rise gradually, and the boiling is not so vigorous. At 290 deg. the material boils quietly. At 305 deg. the mass is quiet and gives off very little steam. At 350 deg. the material starts to boil, and more steam is given off, and, when the temperature reaches 370 deg. the mass is again boiling vigorously and considerable steam is being liberated. Just before the temperature rises above 370 deg. the material is boiling quietly; at 373 deg. it is quiet, very little steam comes off, and when the temperature has reached 415 deg. there is only about 0.1% water left in the gypsum.

The boiling action has been represented in Fig. 2 by parallel vertical lines, and horizontal lines represent the quiet spells. There are two boils; the *first* ends at approximately 300 deg. F.; the second boil begins and ends at approximately 350 and 375 deg., respectively. This description of the "boil" is applicable to nearly all gypsums.

After the kettle has been loaded and the thermometer records 255 deg. (Fig. 2, 1:45 p. m.), the material swells a little and then begins to settle slowly. The relative amount of settling will vary with different materials, and with the same material of different finenesses. In Fig. 2, the irregular curve *LM* represents, fairly closely, the settlings and swellings of the gypsum during calcination to 415 deg. F. Settling continues until the temperature again starts to exceed 250 deg. (3 p. m.). At 280 deg. there is a slight swell, but the material settles rapidly be-

tween 290 and 295 deg., and maintains a more or less uniform volume until the temperature reaches 350 deg. It will be noted that there is no "boil" during the latter period. At the beginning of the "second boil" (350 deg.) the material settles quickly and remains more or less constant in volume during this "boil." Just when the temperature begins to exceed 370 deg., there is a rapid and decided swelling of the material, but of short duration, for the mass begins to settle rapidly and will continue to settle if the calcination is prolonged.

There are three "settles." The first begins at about 285 deg. F.; the second "settle" begins at about 350 deg. F., and the third "settle" at approximately 385 deg. F. The amount of settling varies with the fineness of the material and the rate of calcination. The total depth of the first and second settles may equal 2 ft. or more in a 10-ton kettle.

The "boiling" of the gypsum in the kettle is proportional to the rate of dehydration. This rate is not uniform during the calcination, even if a uniform temperature is maintained in the fire box. At the quiescent periods very little dehydration takes place.

While making a small experimental batch of calcined gypsum, in a quart container, I observe that, although steam was seen to rise from the material after the temperature reached 202 deg. F., the mass did not "boil" until the temperature reached 244 deg. It is a question whether the rapid liberation of the steam at the latter temperature causes the gypsum to "boil." Boiling may be due to the particles of gypsum, especially the coarser, exploding when changing from a higher to a lower hydrate. The explosions would break up the particles and cause an increase in the fineness. My experience has been that gypsum calcined to 340 deg. and higher is not coarser than the raw gypsum. Yet, without the aid of some disintegrating action on the particles, the calcined material would be coarser due to (1) volume increase of unit weight of the calcined material; (2) loss of about 2% of the very fine material through the fog stack.

When the kettle is being loaded, the thermometer does not come in contact with the material until the kettle is over half loaded. It would be interesting to know the temperature of the material after the addition of each partial charge (intermittent loading), when the material is not boiling and when it boils.

Settlings and swellings are due to changes in the density and texture of the material at different temperatures, and to the decrease in the weight of the kettle charge as it continues to lose its combined water. Density will be discussed later. The singular behavior of the material, during calcination, should be borne in mind when considering the nature of calcined gypsum.

In calcining by the kettle process, the temperature of the furnace is more or less uniform; the aim is to maintain a uniform supply of fuel. The shape or form of the temperature curve is not due to manipulation of the fire on the part of the calciner; he may increase his fire and thus reduce the total length of the curve; in other words, he squeezes it into less time.

There are two methods of loading kettles: continuous and intermittent. In the former, a steady flow of feed enters the kettle at such a rate that the gypsum boils continuously until loaded. In the latter method, the loading is divided into four or more periods. At the start, the kettle is loaded about one-quarter or one-third full, and no more is added until the partial load is boiling good. In this manner the loading is completed. The time required to load a 10- or a 12-ton kettle

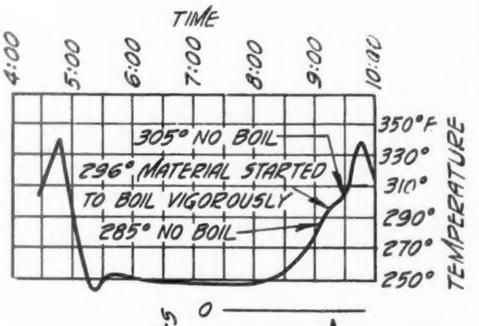


Fig. 3. Temperature curve of a slow boiling action

that is already "hot," will vary from one-half hour to one hour. Cold kettles (just being started up) require a very much longer time for loading. If the kettle is loaded too fast, there is a danger of the mass settling and "sticking" the kettle, due to the inability of the motor to pull the agitators (sweeps) through the dead material. Raw gypsum, although lower in specific gravity, weighs more per cubic foot than most forms of calcined gypsum, but the material corresponding to $CaSO_4 \cdot 1\frac{1}{2}H_2O$ (one and a half molecules of water) is denser than raw gypsum, and as the charge in the kettle during loading is a mixture of the two (without assuming that the former exists as a definite compound) the chances of sticking the kettle, due to fast loading, are increased due to the increasing density of the material at the early stages of calcination.

The temperature of the furnace, or of the stack gases, is a very important factor in the rate of loading kettles. Higher furnace temperatures permit quicker loading; and, if a slow calcination is desired, it is better to cut down the fire after the kettle is loaded. In this connection may be mentioned an unusual phenomenon, called 'boiling over," that occurred at a gypsum plant.

Causes and Effect of "Boil Overs"

The capacity of the plant had been increased by installing more kettles. The raw feed to the older kettles was the product of burr stones, or of burr stones and roller mill mixed, and the fineness of the raw material seldom exceeded 60% passing the 200-mesh (it was usually under 50%). The feed to the new kettles was all roller mill product of a fineness exceeding 80% passing the 200-mesh. Naturally, the same firing rate (gallons of fuel oil per hour) as used for the coarser ground raw gypsum, when applied to the new kettles reduced the calcining period from 2 hours and 40 minutes to 2 hours and less. (The finer material was more bulky.) At that time, such rapid calcination was not considered good practice (the raw gypsum was not dried prior to calcination), and the calciners were instructed to cut their fires so as not to calcine in less than 2½ hours.

Soon afterwards, we started to get quick sets, and the trouble was traced to the newer installation. Tests from numerous samples from kettle dumps, purposely held in the hot pit for inspection, showed that several dumps contained raw gypsum. This raw did not leak into the hot pit while the kettle was being reloaded. Indeed, the gates did not leak at that time, although they did leak later; i. e., when they got older.

In the meantime, the unusual phenomenon of "boiling over" was happening in the kettle. One day the charge in the kettle, literally, exploded and discharged more than a ton of plaster through the various openings on top of the shell cover. This occurred when the temperature of the material was approximately 350 deg.; the temperature immediately dropped about 20 deg., then started to rise at the usual rate until the dumping temperature was reached. The explanation given at the time was that a collection of the damp raw gypsum in the fog box had dropped into the kettle. This "boiling over" happened several times in a short period and we were still encountering the quick sets, but no kettle leaks. It was therefore assumed that the quick sets were due to the fog box emptying into the calcined charge when the latter was being pumped into the hot pit. The calciners were supposed to clean out the fog boxes regularly, but to counteract any delinquency, slides were installed at the base of the fog box, and this slide had to be closed at about 310 deg. But the "boiling over" continued, and the quick sets also.

One of the calciners expressed the opinion that there was raw gypsum at the bottom of the kettle; this seemed incredulous. He said he could tell, by the pull on motor, when to expect a "boil over," but sometimes it did not happen when he expected it. I had this calciner advise me, so that I could be present, when he was expecting a "boil over." But the expected explosion did not occur, and the charge was dumped into the hot pit. While it was being dumped I took several samples from the discharge chute. One of the last samples analyzed 17.63% combined water, or 84.27% raw gypsum. The other samples varied from 4.5% to 13.9% combined water.

We had observed that when the kettle

"boiled over" the plaster was *not* quick setting. So, instead of calcining to 350 deg., for single boil stucco, we raised the temperature to 370 deg. and held it there for 5 minutes; if raw gypsum were present it would react with the calcined material at that temperature, if not before. This was a temporary remedy. We shut down one of these kettles soon afterwards, as it would not discharge quick enough into the hot pit, due to some obstruction. We found a lump of raw gypsum (fine material, caked) in the opening leading to the discharge gate. It was large enough to almost cover the opening.

The final remedy for preventing this unusual condition, was to increase the fires and carry a good heat in the fire box. In addition, small extension scrapers were attached to the extremities of the bottom sweep so as just to clear the walls of the shell and sweep the bottom and periphery of the kettles thoroughly.

Actual Kettle Temperatures

Fig. 3 shows the temperature curve of a slow calcination to 340 deg. F., made at a different gypsum plant than the one referred to above, and it required 5 hours. The slow calcine was intentional, but was not for the purpose of producing a "boil over" condition. However, there was a minor "boil over" and its effect is seen on the temperature curve, and, which is more interesting, on the settle and boiling of the material in the kettle, the lines of which are also shown in Fig. 3. At 285 deg. the material was fairly quiet and started to settle rapidly. At 296 deg. it started to boil vigorously and swelled 15 in. in a few seconds; then it started to settle immediately and conformed to the usual behavior with increasing temperature. The cause of the above "boil over" is not known. The unusual boiling and swelling at 296 deg. explains the reason for the ejection of a considerable quantity of plaster from the kettle when the quantity of raw gypsum present is considerable.

The temperature of the material during calcination is recorded on a temperature-time chart by the pen-arm attached to the pressure element of a recording thermometer, gas filled type. These thermometers, as a rule, register slower than mercury thermometers. They get out of order and require checking. Recording thermometers, of the above type, should be checked at the *dumping* temperature and not at, as it is sometimes called, the boiling temperature (245 to 250 deg. F.), as the following checks will show.

Checks on a recording thermometer were made against a mercury thermometer, industrial type. Both were placed in the kettle charge about 2 in. apart. In one test, in order to get both thermometers to check at 340 deg. F., the recording instrument was adjusted so that it registered 276 deg. on the first horizontal "boiling" line, whereas, the mercury registered 247 deg. In another checking test, the recording registered 300 deg. on the horizontal (mercury 247 deg.) after the adjustment was made at 340 deg. Analysis of kettle samples, taken on top of the hot pit as soon as the material has been dumped, is also a good method of checking the thermometer.

During the calcination there is a variation in the horsepower required to drive the agitating and mixing mechanism (gears, shaft, cross-arm and sweeps). For a 10- or 12-ton kettle, a 25-hp. motor is usually used. After the kettle is loaded and the material is boiling vigorously, the load on the motor is small. I have made no tests at temperatures below 260 deg., but I venture to say that the load, with a 10-ton charge in the kettle, would not exceed 12 hp. The purpose of the driven mechanism is to agitate the material and prevent it from settling, but as long as the material is boiling vigorously and continuously, mechanical agitation may be dispensed with for a considerable period.

When the temperature exceeds 250 deg. and the boiling is less vigorous, the load on the motor increases, and when the first settle occurs, about 19 hp. is required to pull the load. At the beginning of the second boil (approximately 350 deg.) the load decreases to 15 hp. As soon as the material enters the second settle stage, about 19 hp. is required. Then the material boils vigorously (second boil) and the load drops to 15 hp., but it gradually increases, and at 375 deg. equals 22 hp. and increases rapidly thereafter.

In the manufacture of gypsum stucco (single boil or first settle) it is customary to dump at from 340 to 350 deg. F. This material is the base of nearly all gypsum plasters, expect Keene's cement. For casting, molding and finishing plasters some manufacturers prefer to calcine to second settle (double boil). When the material, whether single or double boil, reaches the desired temperature, the kettle gate is opened and the plaster empties into the hot-pit, and from there it is elevated to storage bins.

(To be continued)

Gypsum in 1929

THE GYPSUM industry in 1929 continued active but was not so productive as in 1928, says a statement made public by the United States Bureau of Mines, Department of Commerce, based on reports received from 59 operators in 17 states and collected in co-operation with the geological surveys of Iowa, Kansas, Michigan, New York, Oklahoma, South Dak., Texas and Virginia.

The quantity of gypsum mined in the United States in 1929 was 5,016,132 short tons, a decrease of 86,118 tons, or 2%, compared with 1928, according to the Bureau of Mines statistics. This production, however, was greater than that of any year prior to 1924 and more than twice that of 1919.

The total value of the calcined and uncalcined gypsum sold by producers was $31,292,969, a decrease of $743,194, or 2%, compared with 1928. The quantity of gypsum sold by producers without calcining in 1929 was 1,065,697 short tons, an increase of 66,285 tons, or 7%, over 1928, and was valued at $2,096,779, or $1.97 per ton, an increase of $194,745, or 10%, in value and of 7 cents per ton; the quantity of calcined gypsum sold by producers was 3,361,580 tons, a decrease of 279,805 tons, or 8%, and was valued at $29,196,190. This was a decrease of 3% in total value compared with 1928.

New York continues to be the largest producer of gypsum. The production of crude gypsum in that state in 1929 was 1,284,338 tons, a decrease of 15% from that of 1928. This was 26% of the entire quantity mined in the United States. New York is also the largest seller of gypsum, marketing 298,793 tons without calcining, or 28% of the United States total, and 859,147 tons calcined, or 26% of the total. These figures represent an increase of 11% in the uncalcined and a decrease of 20% in the calcined gypsum compared with 1928. Other important states in the production of crude gypsum in 1929 were: Michigan, 898,547 tons; Iowa, 718,503 tons; Texas, 520,519 tons; Ohio, 374,008 tons; Oklahoma, 369,433 tons, and Nevada, 225,514 tons. The first five states reported 76% of the total production.

The importation of gypsum constitutes quite an important factor in the industry. In 1929 eight importers with 13 plants in 10 states, namely, California, Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, Virginia and Washington, reported to the Bureau of Mines that they imported 1,017,791 short tons of crude gypsum, an increase of 7% compared with 1928. These importers reported 83,681 tons of gypsum sold uncalcined, valued at $331,979, a decrease of 31% in quantity and 26% in value compared with 1928. The imported gypsum sold calcined in 1929 amounted to 820,737 tons, valued at $7,842,523, an increase of 2% in quantity and value compared with 1928.

GYPSUM MINED AND UNCALCINED AND CALCINED GYPSUM SOLD BY PRODUCERS IN THE UNITED STATES IN 1929, BY STATES

State	No. of active operators	Total quantity mined (short tons)	Sold by producers: Without calcining, Short tons	Without calcining, Value	Calcined, Short tons	Calcined, Value	Total value
Iowa	8	718,503	148,442	$238,734	521,761	$4,430,122	$4,668,856
Michigan	5	898,547	213,657	299,249	481,872	4,016,085	4,315,334
Nevada	5	225,514	43,815	131,735	148,640	1,159,119	1,290,854
New York	11	1,284,338	298,793	707,644	859,147	7,632,208	8,339,852
Ohio	3	374,008	12,190	30,696	356,734	3,270,744	3,301,440
Oklahoma	3	369,433	(*)	(*)	(*)	(*)	2,255,374
Texas	4	520,519	29,991	47,836	416,276	3,392.451	3,440,287
Other states†	20	625,270	‡318,809	‡640,885	‡577,150	‡5,295,461	3,680,972
	59	5,016,132	1,065,697	$2,096,779	3,361,580	$29,196,190	$31,292,969

*Included in "Other states." †Includes Arizona, California, Colorado, Kansas, Montana, New Mexico, South Dakota, Utah, Virginia and Wyoming. ‡These figures include also sales from Oklahoma.

The Calcination or Enrichment of Phosphate Rock*

By C. G. Memminger, W. H. Waggaman and W. T. Whitney
Coronet Phosphate Company, Plant City, Fla.

THE MODERN TENDENCY in all industrial processes is to manufacture or turn out a more concentrated product. This movement has gained considerable impetus in the fertilizer industry within the past decade, owing to increased freight rates, more costly handling charges, and the development of improved methods of producing phosphoric acid and synthetic ammonia.

The demand for high-grade phosphate rock has also increased as new outlets for phosphoric acid and phosphate products have been opened up and the farmer has become educated to the use of more concentrated fertilizers.

While in the early days of the phosphate industry in South Carolina, phosphate rock averaging as low as 60% tricalcium phosphate was regarded as quite satisfactory, the discovery of hard-rock and pebble-phosphate deposits in Florida, both of which were of much higher grade and of greater extent than any previously exploited, caused production to fall off rapidly in South Carolina, and now mining operations have ceased entirely in that state. The standard for domestic phosphate rock was raised from 60% to 68% tricalcium phosphate; and a large export trade grew up for high-grade phosphate rock containing from 75% to 78% of this compound.

Although the hard-rock phosphate of Florida is on the whole of somewhat higher grade, the pockety nature of these deposits caused farsighted operators to concentrate their efforts in developing the more extensive and cheaply mined pebble deposits. This resulted in a falling off in the production of hard rock, but the demand for the higher grades of phosphate still enabled the hard-rock producers to export substantial tonnages of their product and dispose of an appreciable quantity in this country for the manufacture of phosphoric acid for food and chemical purposes.

Development of Calcination Process

Since an attractive premium is paid for the higher grades of phosphate rock, the operators in the pebble field made every effort to compete for this market. Not only were higher grade deposits sought, but the possibilities of enriching pebble phosphate by subsequent treatment of the washed product were vigorously investigated by this company at its laboratory near Plant City, Fla.

The results of these preliminary investigations made it appear that calcination at relatively high temperatures offered a promising method not only of enriching pebble phosphate, but of eliminating as a whole or in part certain impurities which were acid-consuming and imparted objectionable properties to phosphoric acid produced therefrom.

Accordingly experiments were conducted at a pilot plant and the commercial possibilities thus established. Finally two full-sized calcining units were installed with a daily capacity of 600 tons, which have operated more or less continuously for the past 12 years.

A patent was issued in 1916 to C. G. Memminger[2] covering this process, but the details of the plant and the mode of operation have been given no publicity up to the present time. This basic patent is quite broad in its scope and covers the calcining of the phosphate rock at temperatures sufficiently high to bring about the decomposition of carbonates contained therein and to cause the free lime formed to combine with silica, thus insuring a permanent increase in the percentage of P_2O_5 present in the product.

In 1923 a patent was also issued to E. P. Stevenson[3] on a similar process. This inventor claims that, while he heats the rock to a temperature sufficiently high to decompose the calcium carbonate, the free lime does not form calcium silicate, but combines with the tricalcium phosphate to form more basic compounds. This claim does not appear warranted, as more basic phosphate are formed as a rule at exceedingly high temperatures such as those obtained in a Bessemer converter, while calcium silicate is produced at much lower temperatures.

Object of Calcining Phosphate Rock

Although it is the general practice to dry phosphate rock in rotary kilns by means of fuel oil or coal, the temperature of the rock leaving these kilns seldom averages above 300 deg. F. In other words, this procedure is merely for the purpose of eliminating the bulk of the free moisture present in washed pebble phosphate.

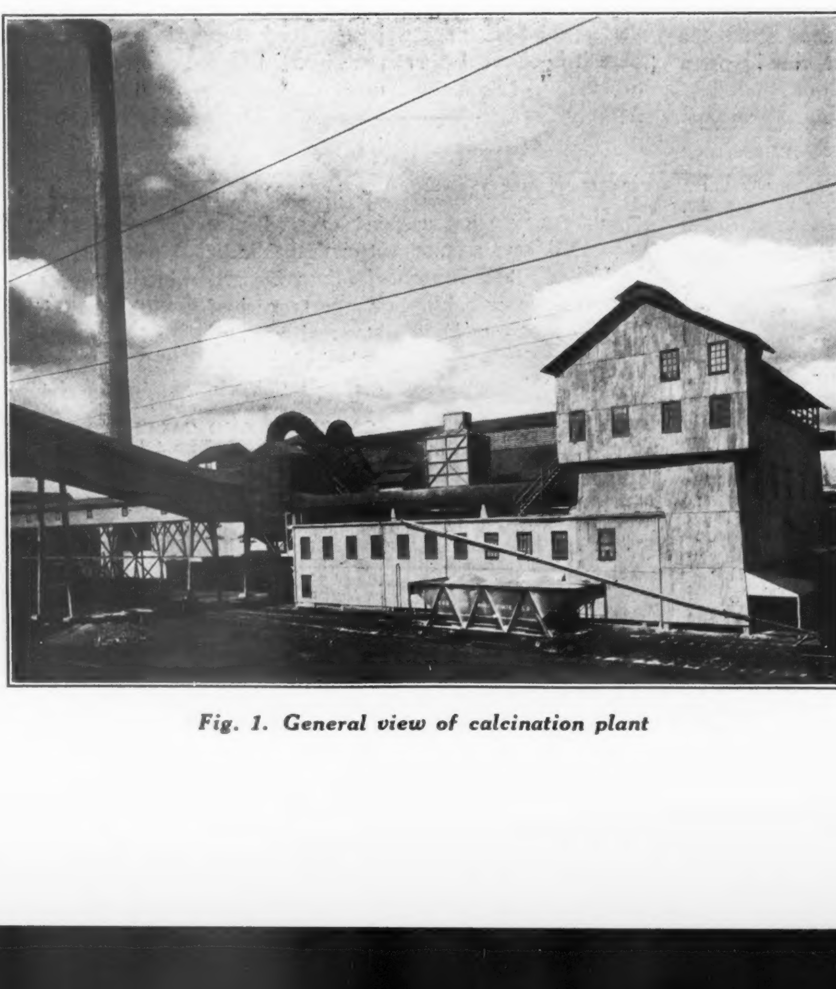


Fig. 1. General view of calcination plant

The object sought in calcining phosphate rock at high temperatures is to increase permanently the percentage of P_2O_5 by the decomposition and volatilization of certain substances present in the rock as impurities or diluents, thus saving freight and handling charges and economizing on the quantity of acid normally required to effect the conversion of P_2O_5 into an available form.

Practically all phosphate rock contains, in addition to phosphate of lime, appreciable quantities of silica, water of

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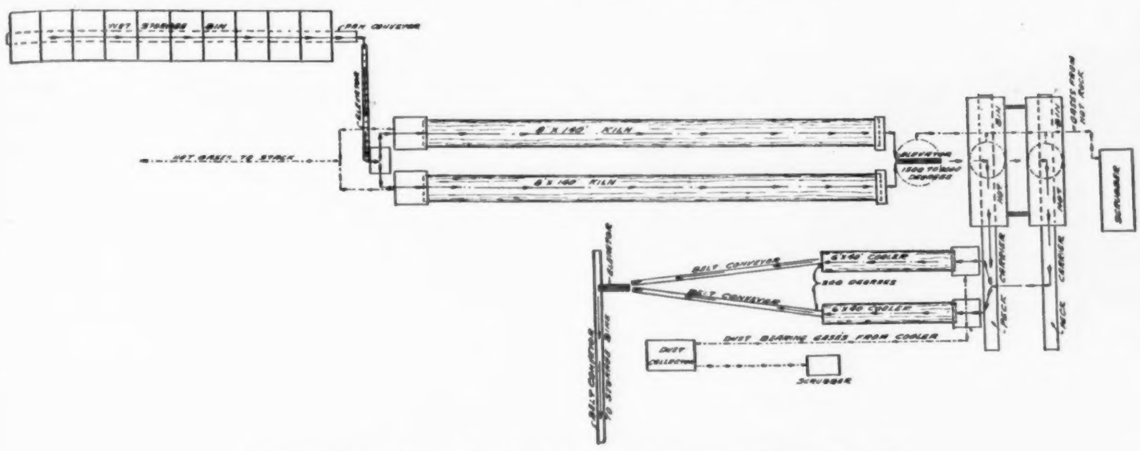


Fig. 2. Flow sheet of calcining plant, Coronet Phosphate Co.

constitution, calcium carbonate, fluorine compounds, and organic matter. Every one of these can be decomposed or partially volatilized at high temperatures when intimately associated as they are in phosphate rock, even the silica present being slightly reduced in the presence of calcium fluoride by the formation of silicon tetrafluoride.

In actual practice, however, the main purpose is to eliminate all water of constitution, burn out or char all organic matter, decompose all or part of the calcium carbonate present, and combine the free lime thus formed with silica so that it will not take up carbon dioxide and be again converted into carbonate. By heating the rock to 2000 deg. F. in an oxidizing atmosphere, practically all of the reactions sought are accomplished with the exception of the complete decomposition of the fluorides, and the tricalcium phosphate content is raised from 4% to 5%.

The commercial use of phosphate treated by this process has shown that in certain instances it is not desirable to bring the temperature of the phosphate rock as high as 2000 deg. F., for, while such a product contains a higher percentage of tricalcium phosphate than that heated to a lower temperature, the physical and chemical nature of the material has certain disadvantages which tend to offset the added concentration of the product.

For instance, where highly calcined phosphate, free from carbonates, is used in the manufacture of superphosphate by the ordinary den process, the action between the acid and the rock dust is so slow that complete decomposition of the phospate is much delayed and the final product is not so porous or so readily cured as that made from phosphate rock containing carbonate of lime. The introduction of improved methods of manufacturing superphosphate, however, wherein the heat of chemical reaction is not dissipated so rapidly as in the den process, may make this highly calcined phosphate more desirable for this purpose than that which is calcined at lower temperatures.

On calcining pebble phosphate at 1500 deg. F. only partial decomposition of the carbonates takes place, and the organic matter, instead of being completely burned out, is reduced to a char. At this temperature the tricalcium phosphate content is increased from 2% to 3%.

Up to the present time the main use of the calcined pebble phosphate in this country, particularly that treated at 2000 deg. F., has been in the manufacture of pure phosphoric acid suitable for food and chemical purposes. As the organic matter is either eliminated by the heat treatment or reduced to elemental carbon which is not attacked by sulphuric acid, calcined phosphate is especially desirable for the manufacture of a pure, clear, colorless phosphoric acid by the wet process.

In Table I, analyses of relatively high-grade phosphate rock before and after combining are given. The various ingredients are also shown combined in a conventional manner.

This table shows that at 2000 deg. F. the pebble phosphate containing 76.17% of tricalcium phosphate may be raised in grade to 80.43%. All of the calcium carbonate originally present is decomposed, the water of constitution driven off, the organic matter completely oxidized, and most of the sulphurtrioxide eliminated. Small quantities of the fluorine are also volatilized.

Since the intense heat zone of the kiln is relatively narrow, owing to the short flame employed, the material is maintained at the highest temperature for a comparatively short period of time, and therefore the calcium fluoride decomposed is only a small percentage of the total amount present. Analyses of both the stack gases and the phosphate product indicate that 3% of the fluorine originally present is driven off at 2000 deg. F.

At 1500 deg. F. a little more than one-half of the calcium carbonate is decomposed, over three-fourths of the organic matter and water of constitution eliminated, and the tricalcium phosphate content raised about 2.5% over that of the original rock. Practically no fluorine is volatilized at this temperature, but for certain purposes this type of calcined

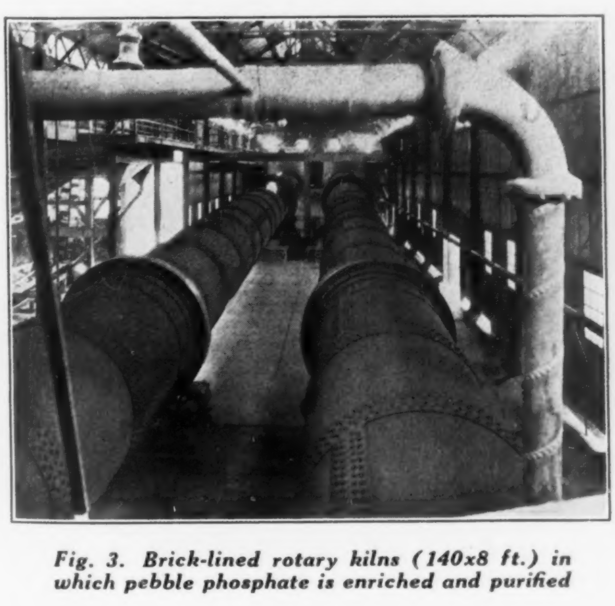


Fig. 3. Brick-lined rotary kilns (140x8 ft.) in which pebble phosphate is enriched and purified

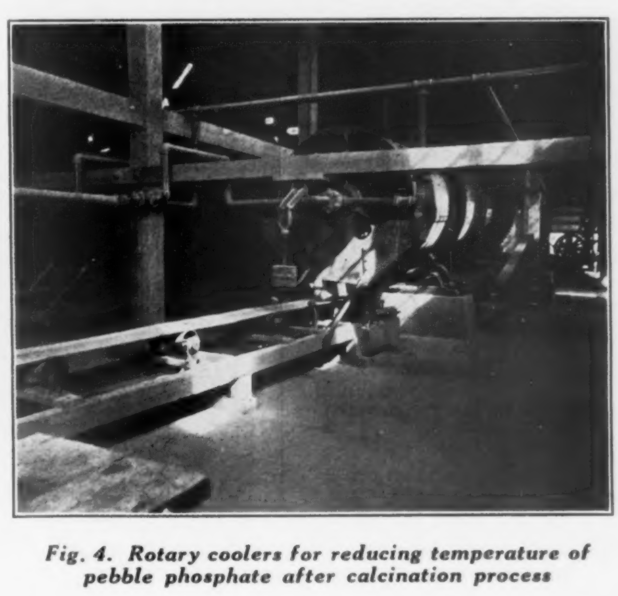


Fig. 4. Rotary coolers for reducing temperature of pebble phosphate after calcination process

phosphate has advantages over that heated to the higher temperatures.

While the composition of calcined phosphate will vary according to the nature and grade of the rock treated, these analyses are typical of the material turned out from the kilns under average operating conditions when calcining high-grade pebble phosphate.

TABLE I. ANALYSIS OF PEBBLE PHOSPHATE BEFORE AND AFTER CALCINING

Constituents	Calcined at 2000 deg. F. Before Pct.	2000 deg. F. After Pct.	1500 deg. F. Before Pct.	1500 deg. F. After Pct.
Moisture	1.03	0.00	0.63	0.11
Organic matter and water of combination	2.50	0.00	1.45	0.40
Phosphoric acid (P_2O_5)	34.86	36.81	34.20	35.32
Carbon dioxide	1.56	0.00	2.70	1.32
Fluorine	3.16	3.23	2.82	2.94
Sulphur trioxide	0.23	0.05	0.44	0.28
Silica	7.55	8.10	6.93	7.28
Calcium oxide	48.15	50.66	48.03	49.12
Magnesium oxide	....	....	0.27	Trace
Oxide of iron	1.14	1.16	0.86	1.05
Oxide of aluminum	1.17	1.19	1.72	1.35
	101.34	101.20	100.05	99.17
Less oxygen equivalent of fluorine	1.34	1.36	1.18	1.24
	100.00	99.84	98.87	97.93
Conventional Combination of Above Constituents				
Moisture	1.03	0.00	0.63	0.11
Organic matter and water of combination	2.50	0.00	1.45	0.40
Tricalcium phosphate	76.17	80.43	74.73	77.18
Calcium carbonate	3.55	0.00	5.45	3.00
Calcium fluoride	6.50	6.62	5.78	6.03
Calcium sulphate	0.39	0.09	0.75	0.48
Calcium silicate	0.00	4.66	....	2.17
Magnesium carbonate	....	....	0.57	....
Silica	7.55	5.69	6.93	6.16
Oxide of iron	1.14	1.16	0.86	1.05
Oxide of aluminum	1.17	1.19	1.72	1.35
	100.00	99.84	98.87	97.93

Plant Equipment and Operation

The plant of the Coronet Phosphate Co. for the production of calcined or enriched phosphate consists of two brick-lined kilns 8 ft. in diameter and 140 ft. in length The kilns are fired with crude oil, air being used to atomize this oil. Each kiln has a pitch ⅝ in. to the foot and opens into a stack. It revolves once in 70 seconds. A short flame is used which creates an intense heat in a narrow heat zone. The stack gases at the cool end of the kilns have a temperature of about 300 deg. F.

The pebble phosphate containing from 10% to 20% of water is fed in at the cool end of the kilns by automatic feeders, and the hot calcined rock is discharged at the hot end at a temperature of 1500 to 2200 deg. F., according to the degree of calcination desired. It requires 1¼ hours for the rock to pass from one end of the kilns to the other. Great care must be exercised in this calcining process to prevent the rock from adhering to and building up on the sides of the kilns.

The red-hot calcined material is carried by bucket elevators to brick-lined hot bins and is then elevated by "peck carriers" up two stories and dumped into chutes leading to two rotary coolers. Large lumps are taken out by a grizzly and crushed to uniform size. In the coolers the temperature of the calcined phosphate is lowered by means of coils of pipe containing running water.

After leaving the coolers the rock is at a temperature where it can be readily handled by any ordinary equipment. It is then carried by bucket elevators and belt conveyors and dumped into concrete storage bins. These bins are of the silo type and have a combined capacity of approximately 10,000 tons.

The gases from the kilns pass out through a stack 256 ft. high. Other dust-bearing gases from the plant are conducted through dust collectors and scrubbers to remove the gaseous fluorine compounds.

Utilization of Heat in Freshly Prepared Calcined Phosphate

The calcination of phosphate rock at high temperatures and the permanently concentrated nature of the product led to investigations on the practicability of utilizing more thoroughly the thermal value of the fuel. This was done by mixing with the calcined product, immediately after it was discharged from the kilns, further quantities of undried pebble phosphate which otherwise would have to be put through rotary driers. In this way the grade of the mixture has been increased from 1% or 2% above the pebble phosphate dried in the ordinary way, and the cost of the calcining at high temperatures has thus been materially lowered.

This scheme was first practiced by this company ten years ago, but was later the subject of a patent taken out in 1928 by George T. Harned[1] and assigned to the Phosphate Mining Co., one of the large producers in the Florida pebble fields. Harned claims that this mixture of calcined and uncalcined phosphate is better adapted for the manufacture of superphosphate than a product which has been completely calcined.

While the calcination process for enriching and purifying phosphate pebble was primarily developed to produce material suitable for export and to meet the requirements for food-grade acid and chemical products, the depletion of the more highly concentrated phosphate deposits has aroused added interest in this process and it is being seriously considered as a means of raising the grade of pebble phosphate which is just below or on the border line of marketable and unmarketable material.

Credit should be given S. D. Gooch for his very efficient aid in developing the calcination process.

[1]Harned, U. S. Patent 1,671,765 (1928).

[2]Memminger, U. S. Patent 1,192,-545 (July, 1916).

[3]Stevenson, U. S. Patent 1,453,571 (1923).

Fig. 5. Rear view of plant showing scrubber for removing gaseous fluorine compounds

Barite and Barium Products

THE Department of Commerce, Bureau of Mines, has published information circulars Nos. 6221 and 6223 on barium and barium products. The circulars were written by R. M. Santmyers, mineral specialist, rare metals and nonmetallic division of the United States Bureau of Mines.

The first circular goes into considerable detail as to the description and uses of barite, history, modes of occurrence and description of domestic deposits and contains a discussion of mining and milling methods.

Circular No. 6223 gives information on barium products, including ground barite, lithopone and various barium chemicals.

Sillimanite, Kyanite, Andalusite and Dumortierite

THE Department of Commerce, Bureau of Mines, has published information circular No. 6255 by Alice V. Petar of the rare metals and nonmetallic division of the bureau on the four silicates of alumina, sillimanite, kyanite, andalusite and dumortierite.

The andalusite minerals are used in the manufacture of spark plugs; kyanite can also be used for spark plugs, refractory brick, china ware and porcelain; dumortierite is used for the manufacture of spark plugs, the only known deposit being at Nevada and owned by the Champion Porcelain Co., manufacturers of the well known spark plug by that name.

The circular gives the method of preparation, production statistics and other data relative to these minerals. Lists of producers and possible buyers of the minerals are appended.

Raw Mix Control in the Manufacture of Portland Cement

Some Observations on the Accuracy of Different Methods

By Arthur J. Pool
Chief Chemist, Peninsular Plant, Consolidated Cement Corp., Cement City, Mich.

THE QUALITY OF CEMENT and the uniformity of its chemical composition and physical properties depend largely upon the proper proportioning of the raw materials, and the accuracy with which the proportions are maintained. After the chemist has determined what the composition of the raw mix should be, it becomes his task to make sure that the composition does not vary beyond certain rather narrow limits.

From the standpoint of accuracy, perhaps the best method of mix control consists of calcining to incipient fusion representative samples from the tanks of raw mix; determining in the resulting clinker the percentages of silica, alumina and lime; and then blending the contents of different tanks to produce a raw mixture containing these essential constituents in proper proportions. However, as this procedure is not usually practicable or even desirable, the chemist may resort to a simpler method which may be the determination of only one constituent, such as calcium carbonate, calcium oxide or carbon dioxide.

"Fixed-Lime" Method

In this method, which may be termed the 'fixed lime' method of mix control, it is assumed that with a certain amount of lime in the raw mix the other essential constituents will be present in approximately correct amounts, so all that is necessary is to keep the calcium carbonate or lime in the raw mix at a certain predetermined figure.

The true calcium carbonate or calcium oxide content of the raw mix need not be determined directly, but may be approximated by the determination of any constituent that bears a fixed relation to the amount of lime present. As a matter of fact, it is not usually necessary to know the amount of lime in the raw mix; but it is necessary to know the exact amount of lime in the clinker produced from the raw mix; what relation the amount of lime in the clinker bears to the amount of control constituent as determined in the raw mix, and the extent of the variations of this relation.

The constancy of the relationship between the amount of clinker lime and the amount of control constituent in the raw mix is highly important. There are several factors that may apparently affect this relationship and lead possibly to incorrect conclusions as to the accuracy of the control method being used. Among the more common ones may be mentioned failures to secure representative samples of raw mix or clinker, inaccuracies in determining the amount of control constituent and the practice of determining the lime in composite samples of clinker or cement representing too long a period of operation. It seems advisable in this connection also to point out that in any method of mix control it is desirable that the coal, if such is used for burning, be as uniform as possible with respect to heating value, ash content and fineness.

With raw materials of fairly uniform composition it does not matter particularly what control constituent is determined, so long as it bears a reasonably close relation to the amount of lime in the clinker. An occasional complete chemical analysis of the clinker will indicate if a change should be made in the amount of lime being carried.

However, with materials containing variable quantities of certain substances, the amount of lime in the clinker may fluctuate dangerously. Under such conditions it is necessary to check quite frequently the composition of the clinker, or it may be possible to use a control constituent better adapted to the materials.

In this article are reported the results of experiments made to determine the suitability of four practicable methods of mix control in connection with raw materials containing variable amounts of iron, sulphates, sulphides, magnesium carbonate and organic matter.

Experimental Procedure

Samples of raw-mix slurry were taken from the tank supplying the kilns and, after allowing sufficient time for the materials to pass through the kilns, corresponding samples were taken of the clinker.

The raw mix samples were dried and finely pulverized, after which the different control constituents were determined. The calcium oxide content of each clinker sample was determined and the ratio of clinker lime to each control constituent calculated.

The tests represent a 10-day period of operation. During this time the clinker lime was caused to vary from 64.1 to 65.9%, thus giving a range applicable to practically any desired composition.

In making the tests, particular care was taken to obtain representative samples of raw mix and clinker. All determinations were made to the second decimal place, with the exception of calcium carbonate, which was determined to the first place. In order to put all the results on a more comparable basis, the determinations are reported to the nearest first place.

Analyses of the coal used for burning were quite uniform, so any errors from this source may be considered negligible.

The control methods investigated were the determination of

(1) Loss on ignition;
(2) Calcium oxide (CaO^a);
(3) Calcium oxide in calcined raw mix (CaO^b);
(4) Calcium carbonate ($CaCO_3$).

The manner in which these determinations were made will be described briefly:

Loss on ignition. One gram of the raw mix was placed in a weighed crucible. The

crucible was covered with a lid and heated gently for the first few minutes after which the lid was removed and ignition continued in an electric furnace for 30 minutes at 1000 deg. C. After cooling in a desiccator the crucible was weighed as quickly as possible. The loss in weight multiplied by 100 was recorded as the percentage "loss on ignition."

Calcium oxide (CaO^a). This was determined by weighing out into a 600-ml. beaker 0.5000 gram of the raw mix, adding a little cold water and 12 ml. of dilute (1-1) hydrochloric acid. After bringing the soluble portion of the sample into solution by digesting on a hotplate, about 200 ml. of hot water were added. The solution was then brought to a boil and 7 ml. of glacial acetic acid, 50 ml. of saturated ammonium oxalate and 10 ml. of ammonium hydroxide (sp. gr. 0.90) added in the order given. Boiling was continued for one minute, after which the precipitate was filtered off. After washing thoroughly on the filter the CaO was determined in the usual manner by dissolving the precipitate in dilute sulphuric acid and titrating with potassium permanganate.

Calcium oxide in calcined raw mix (CaO^b). This determination was made exactly the same as for CaO^a except that the sample used had been calcined in the electric furnace for 30 minutes at 1000 deg. C.

Calcium carbonate ($CaCO_3$). One gram of the raw mix was placed in a 300-ml. Erlenmeyer flask, 50 ml. of 0.4 N hydrochloric acid added, the flask attached to a reflux condenser and after boiling for five minutes, the excess acid was determined by titrating with 0.4 N sodium hydroxide using phenolphthalein indicator. From the amount of excess acid found the percentage of $CaCO_3$ was calculated.

Results

The results obtained by the different methods are given in Table 1. In this table are shown the percentage of control constituent and the clinker lime for each sample, also the ratios of clinker lime to control constituents. At the bottom of the table are shown the maximum, minimum and average ratios for the different methods. By multiplying the difference between the maximum and minimum ratio for each method by the average percentage of control constituent the probable extent of variation in terms of clinker lime will be shown. Figures for these probable variations are also given in the table.

It will be observed that "loss on ignition" shows the greatest probable extent of variation, hence from this standpoint it is the least suitable method. The other three methods are about equally suitable so far as extent of variation is concerned.

In Table 2 is shown the average deviation for each sample. The average deviations were obtained by multiplying the percentage of control constituent in each sample by the average ratio for that particular constituent, then taking the difference between the figure thus obtained and the observed clinker lime.

TABLE 1. EXPERIMENTAL DATA OBTAINED IN THE INVESTIGATION OF THE ACCURACY OF DIFFERENT METHODS OF MIX CONTROL

	Raw mix				Clinker	Ratios			
Sample	Loss %	CaO^a %	CaO^b %	$CaCO_3$ %	CaO (K) %	K / Loss	K / CaO^a	K / CaO^b	K / $CaCO_3$
1	36.4	41.2	63.6	76.7	64.1	1.761	1.556	1.008	0.836
2	36.1	41.3	63.3	76.2	64.1	1.776	1.552	1.013	0.841
3	36.7	40.5	63.8	76.2	64.1	1.747	1.583	1.005	0.841
4	36.4	40.9	63.0	76.0	64.2	1.764	1.570	1.019	0.845
5	36.2	40.8	63.3	76.2	64.2	1.774	1.574	1.014	0.843
6	36.6	40.9	63.5	76.2	64.2	1.754	1.570	1.011	0.843
7	36.7	41.5	63.7	76.2	64.2	1.749	1.547	1.008	0.843
8	36.8	41.1	63.9	76.2	64.2	1.745	1.562	1.005	0.843
9	36.5	41.0	62.8	76.6	64.3	1.762	1.568	1.024	0.839
10	36.1	41.4	63.6	76.2	64.4	1.784	1.556	1.013	0.845
11	36.6	41.0	63.4	76.4	64.4	1.760	1.571	1.016	0.843
12	36.6	41.1	63.5	76.2	64.5	1.762	1.569	1.016	0.846
13	36.7	41.1	64.0	76.4	64.6	1.760	1.572	1.009	0.846
14	37.1	41.2	64.3	76.4	64.6	1.741	1.568	1.005	0.846
15	37.1	41.3	64.4	76.4	64.6	1.741	1.564	1.003	0.846
16	36.3	41.1	63.1	76.0	64.6	1.780	1.572	1.024	0.850
17	36.6	41.5	63.9	76.2	64.7	1.768	1.559	1.013	0.849
18	36.9	41.2	64.4	76.6	64.7	1.753	1.570	1.005	0.845
19	36.0	41.5	63.7	76.6	64.8	1.800	1.561	1.017	0.846
20	36.0	41.5	64.1	76.4	64.8	1.800	1.561	1.011	0.848
21	36.8	41.4	64.1	76.6	64.8	1.761	1.565	1.011	0.846
22	36.6	41.5	63.7	76.6	65.0	1.776	1.566	1.020	0.849
23	36.2	41.5	63.5	76.4	65.0	1.796	1.566	1.024	0.851
24	36.2	41.5	63.9	76.1	65.0	1.796	1.566	1.017	0.854
25	36.9	41.3	64.1	76.2	65.1	1.764	1.576	1.016	0.854
26	37.6	41.2	63.4	76.8	65.2	1.734	1.583	1.028	0.849
27	36.7	42.0	64.8	77.6	65.3	1.779	1.555	1.008	0.841
28	36.7	42.2	65.4	77.3	65.4	1.782	1.550	1.000	0.846
29	36.0	41.6	63.8	76.6	65.5	1.819	1.575	1.027	0.855
30	36.4	41.2	63.4	76.4	65.5	1.799	1.590	1.033	0.857
31	36.7	41.4	65.2	76.6	65.6	1.787	1.585	1.006	0.856
32	36.0	41.7	63.9	76.8	65.6	1.822	1.573	1.027	0.854
33	36.6	41.2	64.1	76.4	65.6	1.792	1.592	1.023	0.859
34	36.9	41.2	64.2	76.4	65.7	1.780	1.595	1.023	0.860
35	36.6	41.6	63.7	76.3	65.8	1.798	1.582	1.033	0.862
36	36.3	42.0	64.3	77.2	65.9	1.815	1.569	1.025	0.854
Average	36.5	41.3	63.9	76.5	64.8	1.774	1.569	1.016	0.848
Maximum ratios						1.822	1.595	1.033	0.862
Minimum ratios						1.734	1.547	1.000	0.836
Differences						0.088	0.048	0 033	0.026
Probable extent of variation in terms of clinker CaO						3.2%	2.0%	2.1%	2.0%

At the bottom of the table are shown the percentages of samples deviating not more than 0.2, and not more than 0.4, in terms of clinker lime, from the observed clinker limes. From these results it appears that the determination of CaO in the uncalcined samples (CaO^a) is the most suitable method, with calcium carbonate holding the next place, the determination of CaO in the calcined samples (CaO^b) the third place and "loss on ignition" the method least suitable.

Discussion

It would be very interesting to explain the exact causes of the differences in the results obtained by the different methods used in this investigation. To be able to do so would require considerable accurate knowledge of the compounds occurring in the raw materials, and of the changes which these compounds undergo when subjected to certain temperatures and other conditions.

With pure chemical compounds it is comparatively easy to obtain data on their reactions and other information which may be desired, but with a complex material like raw mix containing variable and considerable quantities of certain substances it is not so easy to determine the reactions that take place, and the effect certain conditions may have on the speed and completeness of those reactions. However, by considering the effect certain decomposition and oxidation reactions may have on the percentage composition of the material, and recognizing that because of the nature of the control methods used some of these reactions may not occur or may be carried to different degrees of completion, it is easy to understand how variations might have occurred.

The "loss on ignition" does not really represent a constituent of the raw mix. It represents rather a balance between certain reactions of decomposition which cause loss in weight, and oxidation reactions which cause an increase in weight of the sample. When the raw material is burned in the kilns at temperatures several hundred degrees higher than that at which the "loss on ignition" was determined, certain other reactions* may take place that do not occur at the lower temperature.

For example, at the temperature of the electric furnace, water, organic matter and carbon dioxide are driven off; but at least a part of the sulphides are oxidized and re-

*We are not concerned here with those reactions involved in the formation of $3CaO.SiO_2$, $2CaO.SiO_2$, etc., but only with reactions that increase or decrease the weight of the material.

TABLE 2. AVERAGE DEVIATIONS IN TERMS OF CLINKER LIME FOR DIFFERENT METHODS OF MIX CONTROL

Sample	Clinker CaO	Loss × 1.774	Deviation	CaO^a × 1.569	Deviation	CaO^b × 1.016	Deviation	$CaCO_3$× 0.848	Deviation
1	64.1	64.6	+0.5	64.6	+0.5	64.6	+0.5	65.0	+0.9
2	64.1	64.0	—0.1	64.8	+0.7	64.3	+0.2	64.6	+0.5
3	64.1	65.1	+1.0	63.5	—0.6	64.8	+0.7	64.6	+0.5
4	64.2	64.6	+0.4	64.2	0.0	64.0	—0.2	64.4	+0.2
5	64.2	64.2	0.0	64.0	—0.2	64.3	+0.1	64.6	+0.4
6	64.2	64.9	+0.7	64.2	0.0	64.5	+0.3	64.6	+0.4
7	64.2	65.1	+0.9	65.1	+0.9	64.7	+0.5	64.6	+0.4
8	64.2	65.3	+1.1	64.5	+0.3	64.9	+0.7	64.6	+0.4
9	64.3	64.8	+0.5	64.3	0.0	63.8	—0.5	65.0	+0.7
10	64.4	64.0	—0.4	65.0	+0.6	64.6	+0.2	64.6	+0.2
11	64.4	64.9	+0.5	64.3	—0.1	64.4	0.0	64.8	+0.4
12	64.5	64.9	+0.4	64.5	0.0	64.5	0.0	64.6	+0.1
13	64.6	65.1	+0.5	64.5	—0.1	65.0	+0.4	64.8	+0.2
14	64.6	65.8	+1.2	64.6	0.0	65.3	+0.7	64.8	+0.2
15	64.6	65.8	+1.2	64.8	+0.2	65.4	+0.8	64.8	+0.2
16	64.6	64.4	—0.2	64.5	—0.1	64.1	—0.5	64.4	—0.2
17	64.7	64.9	+0.2	65.1	+0.4	64.9	+0.2	64.6	—0.1
18	64.7	65.5	+0.8	64.6	—0.1	65.4	+0.7	65.0	+0.3
19	64.8	63.9	—0.9	65.1	+0.3	64.7	—0.1	65.0	+0.2
20	64.8	63.9	—0.9	65.1	+0.3	65.0	+0.2	64.8	0.0
21	64.8	65.3	+0.5	65.0	+0.2	65.0	+0.2	65.0	+0.2
22	65.0	64.9	—0.1	65.1	+0.1	64.7	—0.3	65.0	0.0
23	65.0	64.2	—0.8	65.1	+0.1	64.5	—0.5	64.8	—0.2
24	65.0	64.2	—0.8	65.1	+0.1	64.9	—0.1	64.5	—0.5
25	65.1	65.5	+0.4	64.8	—0.3	65.0	—0.1	64.6	—0.5
26	65.2	66.7	+1.5	64.6	—0.6	64.4	—0.8	65.1	—0.1
27	65.3	65.1	—0.2	65.9	+0.6	65.8	+0.5	65.8	+0.5
28	65.4	65.1	—0.3	66.2	+0.8	66.4	+1.0	65.6	+0.2
29	65.5	63.9	—1.6	65.3	—0.2	64.8	—0.7	65.0	—0.5
30	65.5	64.6	—0.9	64.6	—0.9	64.4	—1.1	64.8	—0.7
31	65.6	65.1	—0.5	65.0	—0.6	66.2	+0.6	65.0	—0.6
32	65.6	63.9	—1.7	65.4	—0.2	64.9	—0.7	65.1	—0.5
33	65.6	64.9	—0.7	64.6	—1.0	65.0	—0.6	64.8	—0.8
34	65.7	65.5	—0.2	64.6	—1.1	65.2	—0.5	64.8	—0.9
35	65.8	64.9	—0.9	65.3	—0.5	64.7	—1.1	64.7	—1.1
36	65.9	64.4	—1.5	65.9	0.0	65.3	—0.6	65.5	—0.4
Samples within 0.2 of observed clinker CaO			19.4%		50.0%		33.3%		41.7%
Samples within 0.4 of observed clinker CaO			33.3%		63.9%		47.2%		61.1%

tained by the lime, and the alkalies are also wholly or partly retained in the sample. However, at the higher temperature in the kilns the sulphate is decomposed with loss of sulphur, and the alkalies are almost wholly volatilized. Obviously, then, variable amounts of certain substances that are decomposed or oxidized above 1000 deg. C. would affect the relation between the "loss on ignition" and the clinker lime. The presence of variable amounts of carbonates other than $CaCO_3$ would also affect this relation.

What has been said about "loss on ignition" applies also to the determination of CaO in the calcined raw mix, with the exception of the effect of carbonates other than $CaCO_3$.

The relation between the CaO in the uncalcined raw mix and the CaO in the clinker will not be constant when there are variable amounts of organic matter or other decomposable or oxidizable substances in the material.

The $CaCO_3$ as determined in this investigation does not represent the true amount of this compound, as the presence of any substance other than $CaCO_3$ that will react with the hydrochloric acid will affect the results for this determination. Moreover, the relation between the results obtained for $CaCO_3$ and the CaO in the clinker will be affected in the same manner as for the CaO in the uncalcined raw mix, with this possible difference: An increase in the amount of magnesium carbonate, or other substances that will react with the hydrochloric acid, may compensate to some extent for an increase in organic matter or other substances that will, when burned in the kilns, cause a loss in weight of the material.

At the time this investigation was started it was the intention to also investigate the accuracy of carbon dioxide as a control constituent. However, the writer could not see any advantage in this method, as the results obtained for CO_2 would probably be affected similarly, and possibly to a greater extent, than those obtained for $CaCO_3$ by the acid and alkali method.

Other Considerations

The method of mix control used should not, in the writer's opinion, be selected for its accuracy to the exclusion of all other considerations. Accuracy is, to be sure, of unquestionable importance, but the time required and the probabilities of errors in making the tests by different methods should also receive consideration. A relatively simple method may not have quite the accuracy of a more complicated one, but under certain circumstances it may in practice have advantages that more than compensate for its lack of accuracy, provided of course that the inaccuracy is not too great. On the other hand, a method should not be used solely because it is simple, easy and rapid; but a thorough study should be made of the relative accuracy of different methods and consideration of other circumstances peculiar to the plant.

Although a method of mix control that gives excellent results at one plant may be entirely unsuitable at another, it is believed that the results obtained in this investigation are indicative of the results to be expected with similar materials.

Effect of Boric Acid on the Clinkering of Portland Cement

AN INVESTIGATION to determine the possibility of producing a well-burned clinker at a relatively low temperature, by the use of a small quantity of boric acid as a flux, was begun several months ago by the United States Bureau of Standards. The energy changes which take place during burning were studied by means of heating curves.

Heating curves of mixtures of $CaCO_3$ and SiO_2 in the ratio of $2CaO:SiO_2$ gave evidence of (1) an exothermic reaction at about 1420 deg. C., and (2) an endothermic reaction immediately following, and probably starting before the first reaction is finished. The first is thought to be the formation of $2CaO{\cdot}SiO_2$, as no indication of it is found on the cooling curve, or upon reheating. Heating curves of $2CaO{\cdot}SiO_2$ clinker fail to show this break.

The second reaction is reversible, and is probably the inversion of beta $2CaO{\cdot}SiO_2$ to the alpha form, as the temperature at which it occurs corresponds with the generally accepted temperature for this transition.

The first reaction is not affected by the addition of small quantities of boric acid to the raw material, but the second was found to occur at progressively lower temperatures with increasing amounts of boric acid. The refractive indices of the clinkers were also lowered by the addition of boric acid, and from these two facts it is held possible that some of the boric acid forms a solid solution with the silicate.

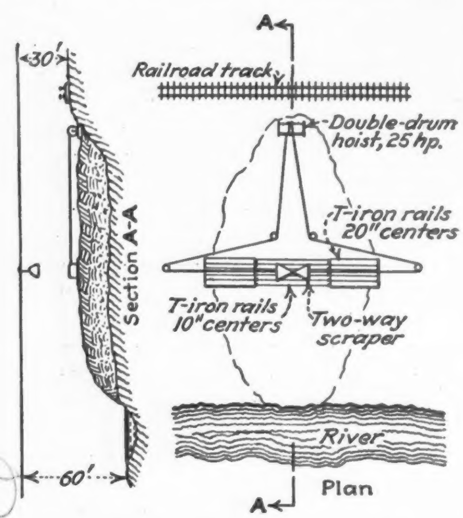
Mixtures of CaO, SiO_2, Al_2O_3, Fe_2O_3, and MgO approximating the composition of portland cement gave curves similar to those for the $CaO{-}SiO_2$ mixtures. The exothermic break came at about 1300 deg. C. in these mixtures. The addition of boric acid had little apparent effect on the shape of the curves. The clinkers containing boric acid, however, were better burned than those without boric acid. Contrary to expectation, the clinkers containing boric acid also had a higher percentage of free lime than the others.

It is planned to make a systematic study of the portion of the ternary system $CaO{-}SiO_2{-}B_2O_3$ in the region between $CaO{\cdot}SiO_2$, $3CaO{\cdot}SiO_2$, and 5% B_2O_3, in order to interpret the phenomena already observed as well as to obtain additional information. Other systems may be studied later, if it appears advisable.—*Technical News Bulletin* of the U. S. Bureau of Standards.

Hints and Helps for Superintendents

Spreading Crushed Aggregate on the Stockpile

A SIMPLE, one-man method of spreading aggregate dumped from an overhead conveyor or aerial tramway is described in *Coal Age*. It is shown schematically in the accompanying sketch. Directly under the rope is laid a floor of T-iron rails of 60-lb.



Scraper for stockpiling aggregate

weight, set at about 10-in. centers, on which the rock is dumped. This floor is extended across the dump by 25-lb. T-iron rails set at 20-in. centers, and on it moves a two-way scraper operated by sheaves and ropes to a 25-hp. double-drum hoist. The idea has the merit of simplicity, and requires only portable equipment.

Gravel Operators Make Their Own Railway Ties

J. A. WHYTE, superintendent of the Texarkana, Tex., operations of Gifford-Hill and Co., believes in using the resources of his state to the fullest advantage whenever possible. At the company's new plant near Texarkana most of the timber and framework used in its construction was secured from the locality and sawed to the proper dimensions on a small portable sawmill. This sawmill is also used for producing cross-ties for the many sand and gravel operations that the company has scattered over the state of Texas.

The saw is of the circular type, made by the American Saw Mill Equipment Co., and is known as a No. 1. It is driven by a 60-hp. Waukesha gasoline motor, but a 30-hp. motor would be sufficient, it is said; the larger size is used, as the company happened to have that size on hand and available. Two men are all that are required to operate the mill.

Gravel operators making their own railway ties with small portable sawmill

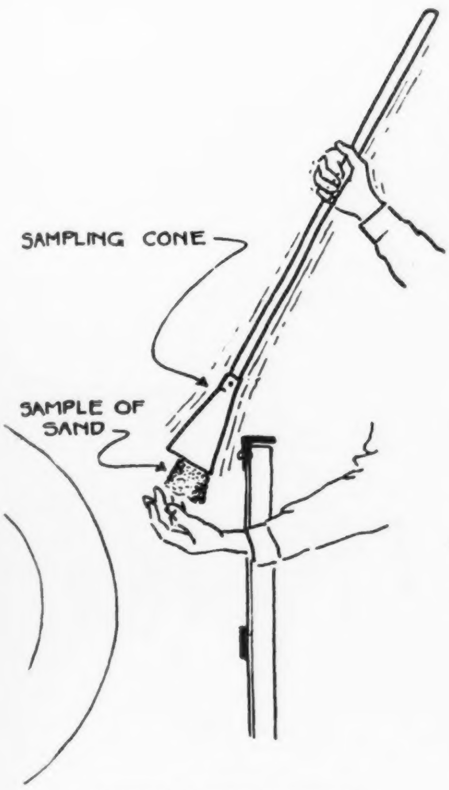
Simple Bridge Structure

MOST of the business of the Travis Sand and Gravel Co., near Austin, Tex., is trucked across the Colorado river to the city. To get into the city over the main highway bridge involved no little road construction through a more or less hilly country, so the management of the Travis company built a simple bridge across the river and put the plant within easy and short trucking distance of the city. This bridge is better described by reference to the accompanying view, which shows the two trough-like tracks for the trucks to follow, doing away with considerable planking expense, side rails, etc. The bridge is both simple and inexpensive, and not difficult to replace in case of washouts. The important "hint," however, is the fact that a little preliminary thought was given the ways and means and costs of trucking, and in this case made it possible for the producer to reach the commercial centers of the city in competition with other producers who were more advantageously located when trucking distance is considered.

Simple bridge structure built across river to shorten trucking distance

Cone for Sampling Sand

HERE is a simple, safe and time-saving device for taking a sample of sand or other material from a mill while it is running. Note the illustration, plainly showing the construction. The cone is made of light sheet metal securely fastened to a stick of convenient length. By means of the stick the cone is jabbed into the sand and enough



Cone for sampling sand

of it wedges into the cone to serve as a sample.—*National Safety News.*

Chart for Finding the Solids in a Mixture

THE CHART given here may be used for many purposes in the washing of sand and gravel or crushed stone. Some of them are:

1. To find the percentage of solids in a pump discharge.
2. To find the plant losses in fine sand or stone.
3. To determine the clay carried in the wash water so as to judge if sufficient water is being used.
4. To calculate the needed volume of a settling pond or to find how much a given pond will hold.
5. To find the tonnage flowing from a sand-settling device.
6. To find the weight and pressure due to the contents of a tank or bin containing a mixture of solids and liquids.

Other uses will suggest themselves as one becomes familiar with the method. To use it the weight of some volume of the mixture compared with an equal volume of water must be known, i. e., the specific gravity of the mixture. Where the solids are fine an ordinary quart bottle and a good spring balance weighing to ¼-oz. are all that is needed for this.

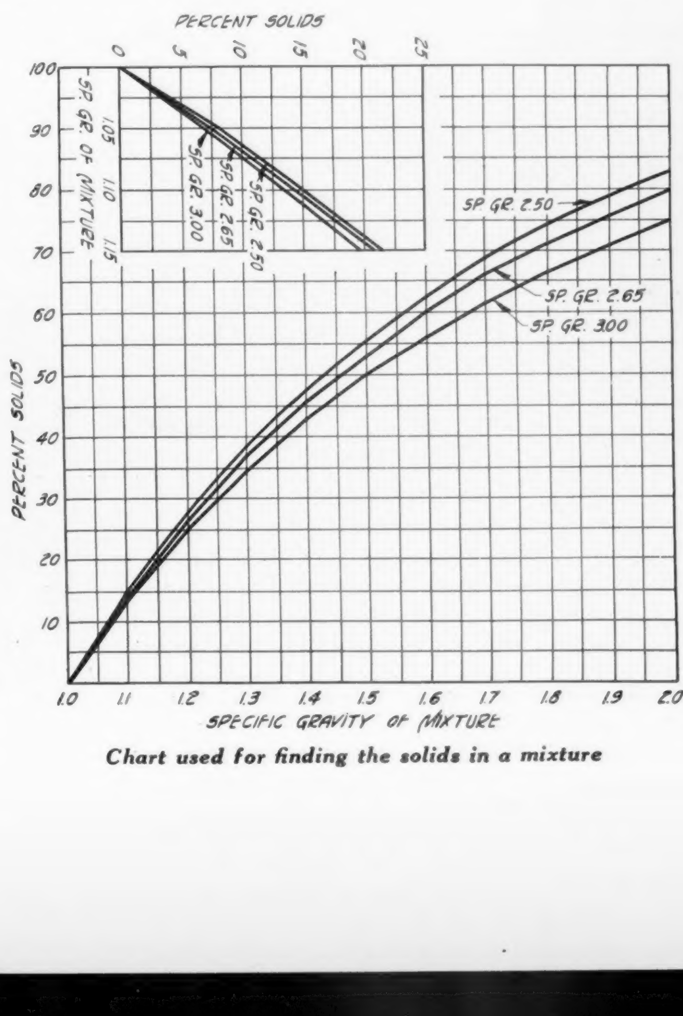


Chart used for finding the solids in a mixture

Example 1. To find the percentage of solids in a dredge pump discharge when 204 tons per hour of sand and gravel are saved as shown by the car weights and 4000 g.p.m. of waste water with a specific gravity of 1.02 are discharged.

The weight of 1 gal. is 1.02×8.33 or 8.5 lb.

Then 4000×8.5÷2000, or 17 tons, is the total weight of waste water and solids.

From the chart a specific gravity of 1.02 is equivalent to 3.5% solids and 3.5% of 17 tons is 0.595 tons, the solids wasted in 1 min. The water wasted is 17—0.595, or 16.4 tons. Then:

	Tons per hr.
The solids in the carloads are	204
The solids wasted, 0.595×60, are	35.8
Total solids	239.7
Water with carloads (assumed)	204
Water wasted, 16.4×60	984
Total water	1188

239.7÷(1188×239.7)=0.168, or the pump discharge contains 16.8% of solids.

Example 2. How many tons of material will a settling pond 60 ft. square and 4 ft. deep hold if the mixture is settled to 30% moisture?

From the chart, 30% moisture, or 70% solids, has a specific gravity of 1.76.

As 32 cu. ft. of water weighs a ton, the pond will hold 60×60×4÷32 tons of water, or 450 tons. It will therefore hold 450×1.76, or 792 tons of material, wet. The weight of dry solids will be 70% of this, or 554.4 tons.

This method may be used to find the area of a settling pond that will hold the waste for a week or other period, or of two ponds which are to be emptied alternately so as to give a long period of settling.

Similar charts may be found in books on metallurgy or industrial chemistry, but if they include the range of rock products materials they are rather hard to read closely. The percentages of solids depend upon the specific gravity of the solids and curves for specific gravities of 2.50, 2.65 and 3.00 are given. The 2.65 curve is used in the above examples and this should always be used where the actual specific gravity of the solids is not known.

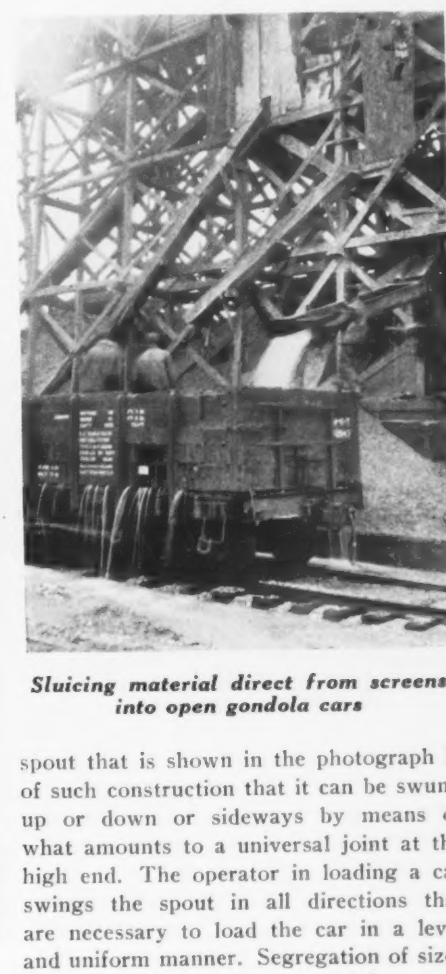
The formula for finding the percentage of solids is:

$$P = \frac{s(a-1)}{a(s-1)}$$

s being the specific gravity of the solids and *a* the specific gravity of the mixture. The answer is in hundredths.

Preventing Segregation

THE PLANT of the Potts-Moore Gravel Co., Waco, Tex., does not have any bin storage, but takes the material direct from the Gilbert screens and sluices it into the open gondola cars. The metal spout that is shown in the photograph is of such construction that it can be swung up or down or sideways by means of what amounts to a universal joint at the high end. The operator in loading a car swings the spout in all directions that are necessary to load the car in a level and uniform manner. Segregation of sizes by this method is kept at a minimum.



Sluicing material direct from screens into open gondola cars

Duluth, Minn., Cement Mill Going Strong

OPERATIONS at the Duluth plant of the Universal Atlas Cement Co. are at the 100% mark, highest point in nearly four years, Ray S. Huey, general superintendent, announced recently. Present indications are that present activities will continue without a let-up until some time in September.

About 350 men are employed at the plant, which started early in April to take on additional help in anticipation of a record business this summer. The crews were increased gradually until a few days ago, when full capacity of the institution was reached, Mr. Huey said.

Unusual demand for cement for public highway construction work all over this area is given by Mr. Huey as the reason for the capacity operations at the Duluth plant. The territory served by the local company includes Minnesota, North and South Dakota, northern Wisconsin and upper Michigan.

The clinker department was the first to operate at full blast early in April, while work in the finishing mill increased gradually throughout the spring and early summer months.—*Duluth* (Minn.) *Herald.*

Trade Complaint Against Cement Industry Dropped

GRANTING THE PRAYER of the respondents in the case of the Federal Trade Commission vs. the Portland Cement Association, which was charged with circulating statements disparaging to the vibrolithic method of constructing highways, the Federal Trade Commission has dismissed its complaint issued July 19, 1928, against the association because of lack of jurisdiction, it was announced June 18 by the commission.

Charges contained in the complaint specify seven methods of circulating publicity which, the commission held, had an unfair effect on the business of the American Vibrolithic Corp.

Observing that one of the principal uses of cement is in the construction of concrete highways, the commission's complaint charged that competition for contracts in this field is keen, and a large part of the respondent's activities is promoting the construction of concrete roads, as well as aiding its members in securing outlets for their products.

The American Vibrolithic Corp., according to the complaint, is the licensee under patents covering certain methods of constructing roads. This method was described as consisting of "spreading over the bed of concrete, while fresh and before it has set, a layer of broken stone, and placing over that planks laid ½ in. apart, and driving over the platform thus formed a heavy machine which delivers rapid, powerful downward blows on the surface of the planks as it passes."

The formula recommended in connection with this process requires less cement, according to the complaint, "estimated as several thousand barrels per mile of road." Agents of the respondent corporation, the complainant charged, had been provided with printed matter designed to promote adoption and construction of concrete roads generally and "especially of a type other than that produced by the methods controlled by the American Vibrolithic Corp. and disparaging the merits of the Vibrolithic type."

The full text of the commission's announcement follows:

"Because of lack of jurisdiction the Federal Trade Commission has dismissed its complaint charging the Portland Cement Association, its board of directors, officers and members with practicing unfair methods of competition.

"It had been charged that this association, composed of close to 100 manufacturers who make and sell about 95% of the cement produced in this country, circulated statements disparaging to the vibrolithic method of road construction."

New Gypsum Product to Be Made in Indiana

MANUFACTURE of a product which is made for hardened gypsum and used for various kinds of electrical work will provide a new industry for Rushville, Ind., according to the announcemnet of C. T. DeHore, president of the Indianapolis and Southeastern Railroad Co., who is financially interested in the new plant.

The factory will be located in an abandoned power plant at Rushville and equipment has already been purchased. The corporation operating the industry will be known as the Electrosone Co. The product, so far, has been used in the manufacture of cell material, runways, cable runways and things of that nature in electric power houses.—*Greensburg* (Ind.) *News.*

Fuller's Earth Plant

A RECENT issue of *Engineering and Mining Journal* carried a complete description of the plant of the Attapulgus Clay Co., owned by the Atlantic Refining Co. and the Standard Oil Co. of New Jersey, and written by H. D. Keiser, associate editor.

The article sets forth that the processing of fuller's earth is an operation requiring special equipment and methods of treating which includes special quarry methods, dryers, crushing and fine screening equipment. It is interesting to note that the plant uses silk-dressed, gyrating sifters much after the practice as found in flour mills.

Crushing is designed to give a gradual reduction and is intended to give a minimum of fines, as the coarse or granular grades are principally demanded by the markets.

American Standards Yearbook

THE AMERICAN STANDARDS ASSOCIATION, 29 West 39th street, New York City, has issued its year book for 1930. The American Standards Association is a federation of 43 national technical societies, trade associations and governmental bodies, whose objects are, according to its own definition: "To provide systematic means of co-operation in establishing American standards to the end that duplication of work and the promulgation of conflicting standards may be avoided; to serve as a clearing house for information on standardization work in the United States and foreign countries; to serve in an international co-operative plan."

Natural Abrasives in 1929

THE PRODUCTION of miscellaneous natural abrasives sold by producers in the United States in 1929, as reported by the United States Bureau of Mines, Department of Commerce, is shown in the following table:

	Short tons	Value
Emery	924	$10,722
Garnet	5,961	435,420
Grinding pebbles and tube-mill lining	4,630	66,178
Grindstones	21,071	617,618
Millstones, chasers and dragstones	....	31,407
Oilstones, whetstones, hones, scythe-stones and rubbing stones	838	212,017
Pulpstones	6,665	623,928
Pumice	60,873	318,579
Tripoli	38,011	545,658

In addition, there were manufactured and sold during the year 126,712 short tons of artificial abrasives valued at $10,821,696, divided as follows: Carbides, 30,309 short tons, valued at $3,060,401; aluminum oxides, 72,614 short tons, valued at $6,471,373, and metallic abrasives, 23,789 short tons, valued at $1,289,922.

Changes at Santa Cruz Plant

SINCE THE ARTICLE describing the operations of the Santa Cruz Portland Cement Co. plant at Davenport, Calif., was written some changes have been made which must be taken into consideration in order that the story in the June 21 issue is not misleading. It was stated that the circulating tonnage from all three Hardinge mills goes through Sturtevant air separators. The present operation is as follows:

The circulating tonnage from No. 1 and No. 2 raw mills, which are 33 in. diameter trunnion mills, is treated in the two Sturtevant air separators. The No. 3 raw mill is a 48-in. diameter trunnion mill and is not being bled for feed to the air separators

Mention on page 46, June 21 issue, that the 24-in. conveyor has a Dings "High Duty" magnetic separator is apparently incorrect. "High Duty" is the trade name for the Stearns magnetic pulley. An error also crept into a caption beneath a suspended magnet. Obviously this is not a magnetic pulley, but merely an electric magnet which functions as a magnetic pulley to remove tramp iron.

Editorial Comment

Research and Production

The "Missing Link in Aggregates," by Gilbert and Kriege, which was published in the June 21 issue of Rock Products, seems to bring aggregate research back to the beginning. The careful tests made by its authors, and the equally careful analysis they have made of the comparative tests reported by Kellermann and Goldbeck, show that the type of aggregate is comparatively unimportant. Differences found and credited to type were largely if not wholly due to differences in cement content, in the proportioning of mortar to voids and in the gradation of the aggregates tested. One may thus hope, with the authors of the paper, that the case of "types of aggregate versus each other" rests.

One cause of faulty conclusions was a bad method of designing the mixes. It is obvious two aggregates cannot be compared on a concrete strength basis unless they are tested with equal amounts of cement. It is almost as obvious that the voids in the coarse aggregates tested should regulate the amount of fine aggregate used. But both these facts were ignored in some of the earlier tests, including the famous Bureau of Public Roads series, although Goldbeck had shown that the use of arbitrary proportions was unfair and uneconomical. The authors of the paper mentioned designed their concretes by the mortar-voids ratio and checked the cement contents of the test pieces by chemical analysis. By thus eliminating two important variables and by grouping the aggregates tested in various ways, they found that differences in concrete strength were due mainly to differences in gradation. And their work from then on has been a study of gradation.

The complete aggregates which gave lowest strengths were found to be lacking in the sizes where the fine aggregate and the coarse aggregate join, from ¾-in. to 10-mesh. It is not unusual to find this condition. Habit has made us think of the smaller particles as fine aggregate, a distinctly different material from coarse aggregate. To keep the two distinct we have insisted that the producer should not let any coarse get into the fine and that he should keep fines out of the coarse. To play safe, specifications were drawn that compelled the producer to rob the completed aggregate of much needed particles. For the best results the paper says that from 21 to 29% of these intermediate particles should be present in the complete aggregate. It often happens, however, that there are actual gaps in the gradation where this percentage of intermediate should be present, and the resulting concrete strength is lower than would be expected from the water-cement ratio.

The fact that harsh gradations, which are "gap" gradations either at the middle or the ends, gave low strengths was brought out a few years ago in the investigations of the water-cement ratio strength law made in the laboratory of the Portland Cement Association. In fact, almost every investigator of concrete physics has spoken of the necessity of even gradation and a number have put their findings into a mathematical equation or a curve. References to the curves and equations of Fuller, Talbot, Kitts, Graf and Korn come to mind as having been mentioned in abstracts and original articles published in Rock Products during the past year or so. All these have in common with the best curves given in Gilbert and Kriege's paper that they are smooth curves when plotted in the ordinary cumulative percentage graph and that they do not lack in the sizes of the missing link.

Every engineer who prepares for a really large concrete job investigates the available aggregates to see how they can be combined according to a gradation curve. In spite of this the tendency of late has been to minimize the importance of gradation. It is, of course, of less importance than some other things. But in Walker and Proudley's recent investigation which was undertaken to show that variations in grading within the limits of A. S. T. M. specifications did not affect strength very much, there is a difference of 12% in compressive strength and 11.5% in flexural strength due to gradation in those mixes which had the same cement content and which were mixed to the same workability. If to such a deficiency were added that of a low cement content and of an improper mortar-voids ratio the concrete might be seriously lacking in strength.

Such conclusions as those drawn by this paper are bound to affect aggregate production. They make it necessary for the producer to study the uses of his product even more intensely than he has been doing of late. It will be greatly to his advantage to see that his coarse or fine aggregate is "married to a good partner," so that the complete aggregate is not deficient in the intermediate sizes and the gradation is fairly smooth. At many plants these intermediate sizes are wasted because they cannot be sold under present specifications. It will be to the producer's interest to show the engineer or contractor that mixes may be designed to include these sizes, as will sometimes be possible. It will also be to his interest to study the screening and crushing method to see how intermediate sizes may be produced in only the proper amount. It will be to his interest to see that faulty handling of aggregates after production, resulting in segregation, is not made a cause for specifications which rob the aggregate of these most needed sizes.

But, what is perhaps better than this is the fact that the conclusions of this paper may give the producer a new viewpoint and lead him to think of himself not as selling stone or gravel or slag but selling *concrete aggregate*. He may recognize that what he has to sell has value not because it is made from one of these materials but because it makes concrete. And the better characteristics, over which he has control, he can give it in the process of manufacture, the better concrete it will make.

Concrete Masonry Association's Proposed Five-Year Program

THE CONCRETE MASONRY ASSOCIATION, formerly the National Concrete Products Association, is making plans for the next five years which are intended to place the manufacture of concrete masonry building units of all types on a par with other leading industries of the country. Although these plans are given in detail in a booklet, "A Proposed Five-Year Program for the Concrete Masonry Association,"* which is available to any manufacturer of concrete masonry in the United States or Canada, this article is intended to acquaint the industry with the more important features of the plans.

In the first place, by vote of the board of directors, the name of the National Concrete Products Association has been changed to the *Concrete Masonry Association*. According to these men, "when the original association was organized it was intended as a promotional organization for all classes of concrete products." Furthermore, "one by one, the various branches have pulled away and formed their own organizations," and, "in every case, these associations have done much for their own branch of the industry, leaving an association whose members and potential members are interested primarily in the manufacture and sale of concrete masonry units."

With these thoughts in mind, the directors of the National Concrete Products Association adopted a name which is more typical of the interests of concrete masonry manufacturers. It is believed that this new name will be one of the things which will "infuse the organization with new life and will make for greater interest among manufacturers of concrete masonry units."

The officers for 1930, the men who are sponsoring the five-year program, are listed here:

D. R. Collins, Milwaukee, Wis., president; Austin Crabbs, Davenport, Iowa, first vice-president; A. G. Swanson, Omaha, Nebr., second vice-president; Jack Franklin, Milwaukee, secretary and treasurer, and fourteen directors—D. R. Collins, Austin Crabbs, M. W. Ferguson, Roanoke, Va.; Philip L. Hunt, Salem, Mass.; Nolan Browne, Dallas, Tex.; Daniel Colmar, Albany, N. Y.; Les Schwalbe, Wauwatosa, Wis.; C. J. Herzog, Pittsburgh, Penn.; Ben Wilk, Detroit, Mich.; J. A. Livingston, Toronto, Ont.; W. P. Hews, Yakima, Wash.; A. V. Johnson, Omaha, Nebr.; George Saffert, New Ulm, Minn., and W. W. Gibson, Minneapolis, Minn.

The new association has defined concrete masonry in this way:

"Concrete masonry—The term concrete masonry is applied to block, brick or tile building units molded from concrete and laid by a mason in a wall. The concrete is made by mixing portland cement with water and other suitable materials such as sand, pebbles, crushed stone, cinders, burned shale, or slag."

And any manufacturer producing concrete masonry units which answer this description is eligible for membership in the Concrete Masonry Association.

"It is to be distinctly understood," states the booklet describing the five-year program, "that the efforts of the Concrete Masonry Association will not be confined to any one type of aggregate or unit. It is the intention of the association to work for all and with all types of concrete masonry units."

This program is, indeed, a comprehensive one. Its main features are: (1) preparation of sales manual, (2) a monthly news letter, (3) publicity, (4) an adequate research program, (5) education, (6) a paid secretary, (7) building code work, (8) elimination of waste, (9) national advertising, and (10) building membership.

The directors believe that "every point" in this program "is needed for the good of the industry." At the present time, those features of the program which will increase the merchandising activities of the concrete masonry industry probably will receive the most attention. Intelligent merchandising seems to be necessary in the industry.

To date, the burden of responsibility for carrying out the proposed five-year program has been shouldered by the organization's officers. Progress in putting this program into effect will be measured by the number of manufacturers of concrete masonry units who become members of the Concrete Masonry Association. The officers and directors of the organization feel that the "successful accomplishment" of this program is "essential to the life of the industry." In fact they say that "if the concrete masonry industry is really looking forward to its own development and progress, there will be a spontaneous response to this program." It is almost needless to add that the industry has long needed such a program.

Few, if any, of the features of this comprehensive program can be carried out until the Concrete Masonry Association has sufficient membership to underwrite the various activities which are planned. Glancing through the program as it is written today, one notices that the expression, "as soon as sufficient funds are available," appears quite frequently. The reason for this is readily apparent—no organization can carry out as comprehensive a program as this, or even one which is one-tenth as comprehensive, without necessary funds. To carry on the good work which is planned, a rather equitable system of dues has been established. Yearly dues to the Concrete Masonry Association, payable quarterly, have been fixed by the directors as follows:

Class "A"—producing over 500,000 units annually	$100.00
Class "B"—producing between 250,000 and 500,000 units annually	50.00
Class "C"—producing less than 250,000 units annually	35.00
Associate—producers of raw material and equipment	35.00

It is interesting to note that numerous requests for copies of "A Five-Year Program for the Concrete Masonry Association" have been received by D. R. Collins, president, indicating that the progressive manufacturers of the country are interested in the industry's development and progress.

Referring to the program itself, Mr. Collins says, "The various features have been worked out after receiving the reactions of many leaders in the concrete masonry industry—men who have been or are manufacturers, trade association executives, machinery manufacturers and others who are heart and soul with any progressive movement for the betterment of our business.

"The opportunity to see how seriously the concrete masonry industry takes its own business is presented in this program. The response of manufacturers will give the answer—and let it be *forward.*"

*Write to D. R. Collins, president, Concrete Masonry Association, 87 27th street, Milwaukee, Wis.

E. H. McEuen in New California Rock Products Enterprise

E. H. McEUEN, of Lindsay, Calif., has taken over the Abramson-Bode quarry east of this city and is shipping raw rock to beet sugar refineries. The rock is burned at the refineries to furnish lime and carbon dioxide gas for precipitating impurities in the beet sugar syrup. The lime, after use, is shipped to agricultural districts and sold as fertilizer and soil corrective.

The industry employs 80 men and more will be added later. Mr. McEuen is also responsible for the establishment of a gravel plant near the lime quarry, where Mr. Holliday of Asuza has purchased 40 acres. He will build a plant for screening and crushing gravel for use in road building and concrete. It is estimated that 50,000 tons are used yearly in Kings and Tulare counties, all of it being shipped in at present.—*Fresno* (Calif.) *Republican.*

P. C. Blaise Promoted by Missouri Cement

P. CARUS BLAISE, recently superintendent of the Independence, Mo., plant, has been promoted to be general superintendent of all three plants of the Missouri Portland Cement Co. His headquarters are St. Louis, Mo.

Mr. Blaise is said to be the youngest general superintendent of several cement plants in the United States and is now only 31 years of age.

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

Stock	Date	Bid	Asked	Dividend
Allentown P. C. 1st 6's[29]	6-28-30	96	100	
Alpha P. C. new com.	6-26-30	23	24	50c qu. July 25
Alpha P. C. pfd.[2]	6-28-30	112	...	1.75 qu. Mar. 15
American Aggregates com.[29]	6-28-30	20	25	75c qu. Mar. 1
Am. Aggre. 6's, bonds (w.w.)	6-17-30	85	...	
American Brick Co., sand-lime brick	6-27-30	...	5	25c qu. Feb. 1
American Brick Co. pfd.	6- 2-30	72	...	50c qu. May 1
Am. L. & S. 1st 7's[29]	6-28-30	96	98	
American Silica Corp. 6½'s[49]	6-30-30	No market		
Arundel Corp. new com.	6-28-30	41	...	75c qu. July 1
Atlantic Gyp. Prod. (1st 6's & 10 sh. com.)[10]	6-30-30	40	50	
Beaver P. C. 1st 7's[29]	6-27-30	94	100	
Bessemer L. & C. Class A[4]	6-27-30	28	33½	75c qu. May 1
Bessemer L. & C. 1st 6½'s[4]	6-27-30	85	87	
Bloomington Limestone 6's[29]	6-28-30	80	84	
Boston S. & G. new com.[47]	6-28-30	17	19½	40c qu. Apr. 1
Boston S. G. new 7% pfd.[47]	6-28-30	46	50	87½c qu. Apr. 1
California Art Tile A	6-26-30	...	9⅞	43¾c qu. Mar. 31
California Art Tile B	6-26-30	...	3	20c qu. Mar. 31
Calaveras Cement com.	6-26-30	...	12⅞	
Calaveras Cement 7% pfd.	6-26-30	...	88	1.75 qu. July 15
Canada Cement com.	6-27-30	13¼	15	
Canada Cement pfd.	6-27-30	92	93	1.62½ qu. June 30
Canada Cement 5½'s[43]	6-26-30	99¾	100¼	
Canada Cr. St. Corp. bonds[43]	6-26-30	95½	...	
Certain-teed Prod. com.	6-28-30	5½	6	
Certain-teed Prod. pfd.	6-28-30	15	25	1.75 qu. Jan. 1
Cleveland Quarries	6-30-30	60	65	75c qu. 25c June 1
Columbia S. & G. pfd.	6-27-30	90	94	
Consol. Cement 1st 6½'s, A	6-30-30	80	90	
Consol. Cement 6½% notes[29]	6-28-30	63	68	
Consol. Cement pfd.[29]	6-28-30	50	60	
Consol. Oka S. & G. 6½'s[12] (Canada)	6-27-30	99	101	
Consol. Rock Prod. com.[44]	6-26-30	1½	2½	
Consol. Rock Prod. pfd.[44]	6-26-30	12	13½	43¾c qu. June 1
Consol. Rock Prod. units	6-23-30	26	29	
Consol. S. & G. pfd. (Can.)	6-27-30	...	85	1.75 qu. May 15
Construction Mat. com.	6-28-30	15	...	
Construction Mat. pfd.	6-28-30	37	38	87½c qu. May 1
Consumers Rock & Gravel, 1st Mtg. 6's, 1948[18]	6-28-30	90	95	
Coosa P. C. 1st 6's[29]	6-28-30	50	...	
Coplay Cem. Mfg. 1st 6's[40]	6-28-30	95	...	
Coplay Cem. Mfg. com.[40]	6-28-30	10	...	
Coplay Cem. Mfg. pfd.[40]	6-28-30	60	...	
Dewey P. C. 6's (1942)	6-30-30	98	...	
Dewey P. C. 6's (1930)	6-30-30	98	...	
Dewey P. C. 6's (1931-41)	6-30-30	98	...	
Dolese & Shepard	6-28-30	78	82	$2 qu. July 1
Dufferin Pav. & Cr. Stone com.	6-27-30	...	19	
Dufferin Pav. & Cr. Stone pfd.	6-27-30	85	90	1.75 qu. July 2
Edison P. C. com.[39]	6-28-30	10c	...	
Edison P. C. pfd.[39]	6-28-30	25c	...	
Giant P. C. com.[2]	6-28-30	6	12	
Giant P. C. pfd.[2]	6-28-30	15	25	1.75 s.-a. June 16
Gyp. Lime & Alabastine, Ltd.	6-27-30	18½	18¾	37½c qu. July 2
Hermitage Cement com.[11]	6-28-30	25	30	
Hermitage Cement pfd.[11]	6-28-30	85	90	
Ideal Cement, new com.	6-28-30	50	52	75c qu. July 1
Ideal Cement 5's, 1943[33]	6-27-30	97	99	
Indiana Limestone units[29]	6-28-30	...	100	
Indiana Limestone 6's	6-28-30	80	80¾	
International Cem. com.	6-28-30	58⅞	60	$1 qu. June 27
International Cem. bonds 5's	6-28-30	99	100	Semi-ann. int.
Iron City S. & G. bonds 6's[46]	6-26-30	...	92	
Kelley Is. L. & T. new st'k	6-30-30	34⅜	38	62½c qu. July 1
Ky. Cons. St. com. V. T. C.[48]	6-25-30	9	10	
Ky. Cons. Stone 6½'s[48]	6-25-30	94	98	
Ky. Cons. Stone pfd.[48]	6-25-30	88	92	1.75 qu. May 1
Ky. Cons. Stone com.[48]	6-25-30	9	10	
Ky. Rock Asphalt com.[11]	6-28-30	12	15	40c qu. July 1
Ky. Rock Asphalt pfd.[11]	6-28-30	85	90	1.75 qu. Mar. 1
Ky. Rock Asphalt 6½'s[11]	6-28-30	90	100	
Lawrence P. C.	6-27-30	54	62	$1 qu. June 28
Lawrence P. C. 5½'s, 1942	5- 7-30	83	...	
Lehigh P. C.	6-28-30	32	33	62½c qu. Aug. 1
Lehigh P. C. pfd.	6-28-30	106	107¼	1¾% qu. July 1
Louisville Cement[7]	6-25-30	230	...	
Lyman-Richey 1st 6's, 1932[13]	6-28-30	97	99	
Lyman-Richey 1st 6's, 1935[13]	6-28-30	97	99	
Marblehead Lime 6's[14]	6-26-30	90	95	
Marbelite Corp. com. (cement products)	6-27-30	200	...	
Marbelite Corp. pfd.	6-27-30	12½	...	50c qu. July 10
Material Service Corp.	6-28-30	16½	19	50c qu. June 1
McCrady-Rogers 7% pfd.[22]	6-25-30	49	...	
McCrady-Rogers com.[22]	6-16-30	20½	21¼	
Medusa Portland Cement	6-30-30	...	94¾	1.50 July 1
Mich. L. & C. com.[6]	6-28-30	25	...	
Missouri P. C.	6-28-30	30	32	50c qu. Aug. 1
Monolith Portland Midwest[9]	6-26-30	2	3	
Monolith bonds, 6's[9]	6-26-30	82½	87½	
Monolith P. C. com.[9]	6-26-30	4½	5½	40c s.-a. Jan. 1
Monolith P. C. pfd.[9]	6-26-30	5½	6½	40c s. a. Jan. 1
Monolith P. C. units[9]	6-26-30	15½	18½	
National Cem. (Can.) 1st 7's[43]	6-26-30	99½	...	
National Gypsum A com.	6-28-30	5	7	
National Gypsum pfd.	6-28-30	27	31	
Nazareth Cement com.[26]	6-27-30	20	...	
Nazareth Cement pfd.[26]	6-27-30	95	...	
Newaygo P. C. 1st 6½'s[29]	6-28-30	102	103	
New Eng. Lime 1st 6's[14]	6-26-30	No market		
N. Y. Trap Rock 1st 6's	6-28-30	99¾	100¼	
N. Y. Trap Rock 7% pfd.[36]	6-26-30	95	...	1.75 qu. Apr. 1
North Amer. Cem. 1st 6½'s	6-28-30	60	61½	
North Amer. Cem. com.[29]	6-28-30	2	4	
North Amer. Cem. 7% pfd.[29]	6-28-30	22	27	
North Amer. Cem. units[29]	6-28-30	25	30	
North Shore Mat. 1st 5's[15]	6-30-30	95	...	
Northwestern States P. C.[37]	6-30-30	110	120	$2 Apr. 1
Ohio River Sand com.	6-16-30	...	17	
Ohio River Sand 7% pfd.	6-16-30	97	...	
Ohio River S. & G. 6's[16]	6-28-30	85	90	
Oregon P. C. com.[9]	6-26-30	...	14	
Oregon P. C. pfd.[9]	6-26-30	...	97½	
Pacific Coast Aggregates pfd.	6-23-30	...	10½	
Pacific Coast Cement 6's[5]	6-26-30	75	77	
Pacific P. C. com.[5]	6-26-30	19	25	
Pacific P. C., new pfd.[5]	6-26-30	75	80	1.62½ qu. Apr. 5
Pacific P. C. 6's[5]	6-26-30	99½	...	
Peerless Cement com.	6-26-30	7½	8½	
Peerless Cement pfd.	6-26-30	72	78	1.75 Apr. 1
Penn.-Dixie Cement pfd.	6-28-30	42	45	
Penn.-Dixie Cement com.	6-28-30	7⅜	8¼	
Penn.-Dixie Cement 6's	6-28-30	80½	82½	
Penn. Glass Sand Corp. 6's	6- 4-30	102	103	
Penn. Glass Sand pfd.	6- 4-30	112	...	1.75 qu. July 1
Petoskey P. C.	6-28-30	9	9¾	15c qu. Apr. 1
Port Stockton Cem. units[9]	2-17-30	...	30	
Port Stockton Cem. com.[20]	6-27-30	No market		
Riverside Cem. com.[20]	6-27-30	...	15	
Riverside Cement pfd.[20]	6-27-30	70	75	1.50 qu. May 1
Riverside Cement, A[20]	6-27-30	11	14½	31¼c Feb. 1
Riverside Cement, B[20]	6-27-30	2¼	...	
Roquemore Gravel 6½'s[17]	6-28-30	99	100	
Santa Cruz P. C. 1st 6's, 1945[5]	6-26-30	105½	...	6% annually
Santa Cruz P. C. com.[5]	6-26-30	90	...	$1 qu. July 1
Schumacher Wallboard com.	6-26-30	10	13½	
Schumacher Wallboard pfd.	6-26-30	21½	25	50c qu. May 15
Southwestern P. C. units[44]	6-26-30	240	300	
Standard Paving & Mat. (Can.) com.	6-27-30	16	17	50c qu. May 15
Standard Paving & Mat. pfd.	6-27-30	84	88	1.75 qu. Feb. 15
Superior P. C., A[20]	6-27-30	36	37½	27½c mo. July 1
Superior P. C., B[20]	6-27-30	10¼	12¼	25c qu. Mar. 20
Trinity P. C. units[37]	6-30-30	130	140	
Trinity P. C. com.[37]	6-30-30	30	40	
Trinity P. C. pfd.[29]	6-28-30	110	120	
U. S. Gypsum com.	6-28-30	37¼	39½	40c qu. June 30
U. S. Gypsum pfd.	6-28-30	120	...	1.75 qu. June 30
Universal G. & L. com.[3]	6-30-30	No market		
Universal G. & L. pfd.[3]	6-30-30	No market		
Universal G. & L., V. T. C.[3]	6-30-30	No market		
Universal G. & L. 1st 6's[3]	6-30-30	No market		
Warner Co. com.[16]	6-28-30	44	46	50c qu. & 25c ex. July 15
Warner Co. 1st 7% pfd.[16]	6-28-30	102	106	1.75 qu. July 1
Warner Co. 1st 6's (w. w.)	6-30-30	97	98	
Whitehall Cem. Mfg. com.[36]	6-26-30	80	...	
Whitehall Cem. Mfg. pfd.[36]	6-26-30	50	...	
Wisconsin L. & C. 1st 6's[15]	6-30-30	95	...	
Wolverine P. C. com.	6-28-30	4½	...	15c qu. May 15
Yosemite P. C., A com.[9]	6-26-30	2¾	3¼	

Quotations by: [1]Watling Lerchen & Hayes Co., Detroit, Mich. [2]Bristol & Willett, New York. [3]Rogers, Tracy Co., Chicago. [4]Butler Beadling & Co., Youngstown, Ohio. [5]Freeman, Smith & Camp Co., San Francisco, Calif. [6]Frederic H. Hatch & Co., New York. [7]J. J. B. Hilliard & Son, Louisville, Ky. [8]Dillon, Read & Co., Chicago. Ill. [9]A. E. White Co., San Francisco, Calif. [10]Lee Higginson & Co., Boston and Chicago. [11]J. W. Jakes & Co., Nashville, Tenn. [12]James Richardson & Sons, Ltd., Winnipeg, Man. [13]Stern Bros. & Co., Kansas City, Mo. [14]First Wisconsin Co., Milwaukee, Wis. [15]Central Trust Co. of Illinois. [16]J. S. Wilson, Jr., Co., Baltimore, Md. [17]Citizens Southern Co., Savannah, Ga. [18]Dean, Witter & Co., Los Angeles, Calif. [20]Tucker, Hunter, Dulin & Co., San Francisco, Calif. [21]Baker, Simon & Co., Inc., Detroit, Mich. [22]Peoples-Pittsburgh Trust Co., Pittsburgh, Penn. [24]A. B. Leach & Co., Inc., Chicago, Ill. [25]Richards & Co., Philadelphia, Penn. [26]Hincks Bros. & Co., Bridgeport, Conn. [28]Bank of Republic, Chicago, Ill. [29]National City Co., Chicago, Ill. [30]Chicago Trust Co., Chicago. Ill. [33]Boettcher Newton & Co., Denver, Colo. [36]Hanson and Hanson, New York. [37]S. F. Holzinger & Co., Milwaukee, Wis. [39]Tobey and Kirk, New York. [40]Steiner, Rouse and Stroock, New York. [43]Jones, Heward & Co., Montreal, Que. [44]Tenney, Williams & Co., Los Angeles, Calif. [46]Stein Bros. & Boyce, Baltimore, Md. [47]Wise, Hobbs & Arnold, Boston. [48]E. W. Hays & Co., Louisville, Ky. [49]Blythe Witter & Co., Chicago, Ill.

INACTIVE ROCK PRODUCTS SECURITIES (Latest Available Quotations)

Stock	Price bid	Price asked
Atlantic Gypsum Products Co. 6's, 1941, $4,000 and 40 shs. com.[1]	35%	...
Atlantic Gypsum Products 6's, 1941, $5,000; 50 shs. com. as bonus[3]	49%	...
Consolidated Cem. com. v.t.c., 3220 shs.[1]	1½ per share	...
Indiana Limestone deb. 7's, 1936, with warrants ($1,000)[4]	$500 for the lot	...

[1]Price at auction by Wise, Hobbs & Arnold, Boston, Dec. 18, 1929. [3]Price at auction by R. L. Day & Co., Boston, Dec. 18, 1929. [4]Price at auction by Adrian H. Muller & Son, Dec. 26, 1929.

Yosemite Cements Annual Report and Balance Sheet

THE FOLLOWING statements and statistics are from the annual report of the Yosemite Portland Cement Corp., San Francisco, Calif., dated June 2, 1930:

SALES—The total sales during the year amounted to 601,174 bbl., compared to 397,464 bbl. during 1928, an increase of 52%. This exceptionally large gain was made in the face of a decline of total cement shipments during the last year from all sources to points within the state of California of 8.2%, according to Bureau of Mines figures.

MARKET—The general market situation and price conditions had very unfavorable effect on net income. Building permits for the three Pacific Coast states show a decline of 11.3% compared to 1928 and 14.5% compared to 1927. A series of successively lower price adjustments was made during the year to meet competitive conditions. The decrease in consumption of cement in the western states is, apparently, responsible for the price changes.

NET INCOME—The net income available for dividends amounted to $124,806.73. This is equivalent to 5.3% on the par value of the Class A common stock outstanding at the close of the year. This profit compares to $72,122.99 earned in 1928, during which period the mill prices were substantially higher. Reduction in unit cost of production was accomplished. The uncertainty as to market conditions and prices makes it important to maintain a strong financial position at this time and not to deplete the cash resources through the payment of a dividend.

PROPERTY—The properties of the company, including the plant at Merced, the limestone quarry at Emory, and the clay deposits at Carbondale, were maintained in first-class condition during the year. In addition to such current maintenance as was necessary, the amount of $73,598.39 was set aside from earnings to provide for depreciation and depletion. At the quarry additional face was opened and a second electric shovel installed for handling the rock.

The value of the plant and property at the end of 1929 was $2,206,581.87. This includes the value of the mill, the clay and rock deposits, and the equipment in the corporation's administrative and general offices, together with the sum of $370,144.40, representing organization expenses, consisting, principally, of commission and expenses incurred in the sale of the corporation's capital stock.

CURRENT ASSETS—Total current assets amounted to $567,629.58. Of this total, $81,853.52 is represented by cash on hand, $39,054.53 by investment in securities, $208,322.83 in customers' accounts receivable, $208,274.65 in inventories of materials, supplies, and cement on hand, and $30,124.05 by notes receivable.

CURRENT LIABILITIES—Current liabilities, consisting entirely of the ordinary running expenses incurred in current operations, amounted to $119,197.33. Current assets amount to four and three-quarters times the current liabilities. This is a particularly good situation. The corporation has no notes payable nor funded indebtedness.

RESERVES—At the close of the year, total reserves amounted to $162,037.34, of which $157,288.82 is specifically provided for depletion and depreciation of plant and property. The reserves for these last named purposes were increased during the year by $73,598.39 through means of appropriations from income.

SURPLUS—The earned surplus as of December 31, 1929, amounted to $187,633.23, an increase of $124,806.73 during the year.

ASSETS

Fixed capital:		
Plant property	$1,836,437.47	
Less reserves for depreciation and depletion	157,288.82	
Remainder	$1,679,148.65	
Organization expenses	370,144.40	
Total fixed capital		$2,049,293.05
Current assets:		
Cash	$ 81,853.52	
Securities	39,054.53	
Notes receivable	30,124.05	
Accounts receivable	208,322.83	
Inventories (based on physical inventories and book values; not verified as to quantities)	208,274.65	
Total current assets		$ 567,629.58
Deferred charges:		
Class B common capital stock issued to organizers	$1,408,000.00	
Other deferred charges	49,826.45	
Total deferred charges		1,457,826.45
Total		$4,074,749.08

LIABILITIES

Capital stock:		
Class A 8% cumulative and participating common capital stock (authorized, 250,000 shares of $10 each; outstanding, 234,790 shares)	$2,347,900.00	
Class B common capital stock (authorized, 150,000 shares of $10 each; outstanding, 140,800 shares)	1,408,000.00	
Total capital stock		$3,755,900.00
Subscriptions to Class A 8% cumulative and participating common capital stock		7,270.00
Current liabilities:		
Accounts payable	$ 94,195.16	
Federal income tax	15,245.97	
Customers' sack redemption account	9,756.20	
Total current liabilities		119,197.33
Reserve for doubtful notes and accounts		4,748.52
Surplus		187,633.23
Total		$4,074,749.08

Recent Dividends Announced

Alpha P. C. com. (qu.)	50c,	July 25
Arundel Corp. com. (qu.)	75c,	July 1
Calaveras Cement pfd. (qu.)	1.75,	July 15
Dufferin Pav. & Crushed Stone 1st pfd. (qu.)	1.75,	July 2
Ideal Cement com. (qu.)	75c,	July 1
Kelley Island Lime & Trans. (qu.)	62½c,	July 1
Kentucky Rock Asphalt com. (qu.)	40c,	July 1
Lawrence P. C. (qu.)	1.00,	June 28
Medusa P. C. com. (qu.)	1.50,	July 1
Missouri P. C. (qu.)	50c,	Aug. 1
Santa Cruz P. C. com. (qu.)	1.00,	July 1

Banker's Statement About the International Cement Corp.

HAYDEN, STONE AND CO., New York City, bankers of the International Cement Corp., have issued the following statement: In the initial quarter of this year International Cement had a net income after all charges of $841,481, equivalent to $1.34 per share on 628,883 common shares, as compared with earnings in the first quarter of 1929 of $1.64 per share on 618,924 shares of common stock then outstanding. Thus in the three months ended March 31 last, the company covered the dividend requirement applicable to the period by a margin of 34% despite the general business recession.

The current quarter of International Cement should make a more favorable comparison with the same quarter of 1929 when earnings were equal to $1.86 on the common stock. Earnings for the first half of 1929 were $3.50 per share and first six months' earnings of 1930 should approximate $3.35 per share. Prospects are very encouraging for the last half of this year. During the same period of 1929 the cement market was badly demoralized and very low prices prevailed, caused to a large extent by duty free imports of foreign cement from Belgium. But market conditions have assumed a more orderly aspect and the Hawley-Smoot tariff Bill has become a law. The effectiveness of the tariff will probably prevent a recurrence of the conditions caused by foreign importations last fall. In addition, through rigid economies the management has effected lower operating costs in practically all of the company's plants.

In addition to the improvement in the fundamental domestic situation which a more satisfactory condition of trade and a medium of tariff protection inspire, there is every indication of an exceedingly high volume of roadway construction this summer and fall. The roadway construction program sponsored by the administration at Washington and the many hydro-electric projects of leading public utility companies, all of which require large takings of cement, have begun to take definite shape with the advent of the warm summer months. The same is true of the many desirable "Public Works"—State, Municipal and Federal—throughout the country, which will also require large quantities of cement. It is interesting to note that the recent figures released by Secretary of Commerce Lamont on public construction are the highest in five years. The value of contracts for public works and utilities construction totaled $303,000,000 in the first quarter, an increase of approximately 56% over 1929. Awards for public buildings alone were 33% above the first three months of 1929, the previous record quarter. The value of con-

tracts awarded for highway construction were 61% higher. These developments, of course, are now finding reflection in the current earnings of International Cement.

While residential building is far below a year ago, it must be borne in mind that cement consumed by this class of construction, even during record years, is not high. In 1929 the company earned $7.88 per common share, and such earnings were only slightly below the record 1928 year. Earnings in recent years and other salient statistics are presented below:

Year	No. of plants	Productive capacity (Barrels)	Net income	Com. share earnings
1929	13	22,000,000	$4,950,433	$7.88
1928	13	20,000,000	5,149,388	7.90
1927	11	16,200,000	4,554,172	6.90
1926	10	14,700,000	4,355,199	6.52
1925	10	12,000,000	3,976,385	7.03
1924	7	7,000,000	3,047,507	7.14
1923	7	5,400,000	2,422,577	6.37
		Seven-year average		7.10

It will be noted from the above table that the productive capacity of the company increased by 2,000,000 bbl. in 1929. All of this increase occurred in foreign plants. Three of the thirteen plants of the International Cement Corp. are strategically located at Mariel, Cuba; Sierras Bayas, Argentina; and Montevideo, Uruguay. Shipments from these foreign plants in 1929 were about 21% greater than in 1928. It is the strategic location of all the company's mills, and the excellent control which the management has exhibited over operating costs, that combine to entitle the company to a position of distinction in the industry.

The demand for the company's high-early-strength cement, which is being marketed under the trade name of "Incor," and sells at a somewhat higher price than portland cement, continues at gratifying levels, and the demand for this product was so great that it became necessary to convert the Spocari, Ala., plant to "Incor" production. As a result "Incor" shipments in 1929 were more than double those of 1928, and shipments so far this year exceed 1929 shipments by a very substantial margin.

Wall Street Comment on Monolith Cement

DESPITE AN UPWARD trend in the Monolith Portland Cement Co.'s sales volume since the first of the year, together with rigid economy and increased efficiency in plant operation, earnings for the first half year ended June 30 will not compare favorably with profits, before interest charges and taxes of $350,257 reported for the same period in 1929.

Unsettled price conditions affecting the company's products in the first six months of this year also prevailed during the latter part of 1929, a situation which caused the company to show lower earnings for last year. Net profits, before interest charges and taxes, of $309,761, compared with $442,353 for the previous year.

Sales and net earnings, 1924-1929, inclusive, have been as follows:

	Net sales	Net earnings after charges
1929	$2,421,168	$219,189
1928	2,630,471	375,780
1927	2,645,185	361,909
1926	2,520,753	282,802
1925	2,392,679	442,720
1924	1,908,273	258,300

The Monolith Portland Cement Co.'s downward trend in earnings for 1929 did not, according to officials, impair its financial position. The company on December 31, 1929, showed current assets of $708,175, of which $260,693 was in cash, against current liabilities of $336,737, or a ratio of 2.11 to 1. Total assets were $7,887,487, and earned surplus $364,955.

The company's earnings in 1929, after all charges except taxes, were more than five times annual interest requirements on the $1,000,000 first mortgage 6% sinking fund gold bonds outstanding. Earnings prospects for the last half of 1930 are regarded more favorably than those of the first six months. The company's wet process plant is located at Monolith, Calif., on the Southern Pacific and Santa Fe joint right-of-way. This location is close to raw material supplies, as well as centers of consumption. The plant was originally built by the city of Los Angeles to manufacture cement used in the construction of the Los Angeles aqueduct. Because of its proximity to this location, the company will be benefited considerably by new construction planned this year around the aqueduct. The city's $38,000,000 municipal water bond issue will result in extensive expenditures for building supplies in the territory adjacent to Monolith's plant.—*Wall Street* (New York City) *Journal.*

California Cement Products Manufacturer Omits Dividend

THE California Art Tile Corp., San Francisco, Calif., manufacturers of specialty and decorative tiling, has omitted the regular quarterly dividends on both the class A and B stock, due July 1. The A dividend was 43¾ cents a share and the class B dividend 20 cents a share, passing of which will save the company $7000 this quarter. Initial dividends, at the annual rate of $1.75 a share on the class A and 80 cents a share on the class B stock, were voted January 2, 1929, and have been maintained since.

The company largely depends on the building industry for earnings and the depression in this industry has made sufficient inroads in the company's earnings to necessitate conservation of funds. "In addition," H. C. Montgomery, president, says: "We have expended considerable capital in developing a new tile line, a flooring tile, which will broaden our field. We are about ready to go into production and this has necessitated conservation of our funds. However, we are hopeful that the building industry will improve soon, when it is expected that our earnings will return to normal."

The company has 16,000 class A and 16,000 class B shares outstanding and listed on the San Francisco curb.

Bessemer Limestone and Cement Statement

THE BALANCE SHEET of the Bessemer Limestone and Cement Co., Youngstown, Ohio, for the calendar year 1929, as of December 31, compared with the previous year, is reported as:

ASSETS	1929	1928
Property and equipment	$4,286,784	$4,271,649
Mineral resources	717,438	685,079
Investments	148,807	135,192
Current assets:		
Cash and marketable securities	90,280	390,866
Notes and accounts receivable	717,228	592,264
Inventories	506,492	603,436
Deferred charges	621,135	618,173
Total	$7,088,165	$7,296,659
LIABILITIES		
*Class A stock	$1,500,000	$1,500,000
*Class B stock	2,000,000	2,000,000
Bonded debt	2,279,500	2,412,000
Current liabilities:		
Notes payable	31,220	
Accounts payable	147,492	
Dividends payable	37,500	393,737
Accruals and estate tax	129,041	
Equity in lime property	10,000	
Surplus	953,411	990,922
Total	$7,088,165	$7,296,659
Current assets	$1,314,000	$1,586,566
Current liabilities	345,253	393,737
Working capital	$ 968,747	$1,192,829

*Represented by 50,000 class A and 100,000 class B no par shares.

Construction Materials Corp.'s 1929 Earnings

THE BALANCE SHEET of the Construction Materials Corp., Chicago, Ill., for the year 1929 was published in ROCK PRODUCTS, April 26, 1930; the reported earnings statement follows. This company is one of the largest producers of commercial sand and gravel in the Chicago territory, but also does harbor dredging and fill work, so that its earnings are not necessarily indicative of the financial status of the sand and gravel industry in this locality.

EARNINGS FOR CALENDAR YEAR 1929	
Gross profit	$1,660,446
Depreciation and depletion	126,275
Selling and other expenses	452,326
Federal tax provision	120,000
Net profit for year	$ 961,845
Surplus January 1, 1929	1,246,356
Appreciation of land	299,627
Total surplus	$2,507,828
Dividends paid and accrued	226,044
Reorganization expense	71,623
Provision for contingencies	150,000
Surplus December 31, 1929	$2,060,161
Earnings per share on 185,000 shares common stock (no par)	$3.98

Foreign Abstracts and Patent Review

Comparison of Methods for Feeding Rotary Cement Kilns. E. Schirm states that in order to decrease the formation of dust in a rotary cement kiln, the mix must be dried more slowly in order to form and then retain the mix in lumps. This may be helped by inserting a tube in the rotary kiln head as shown in Fig. 1. The kiln gases pass through this tube and heat the mix only indirectly, which is charged between the stationary and rotary sections of the kiln. As a result, evaporation of the water in the mix is slower and the lumps formed by rotation of the kiln are preserved.

In order to prevent the mix from falling backwards into the rotary kiln, a flange is usually installed at the upper kiln end, but this decreases the discharge area for the kiln

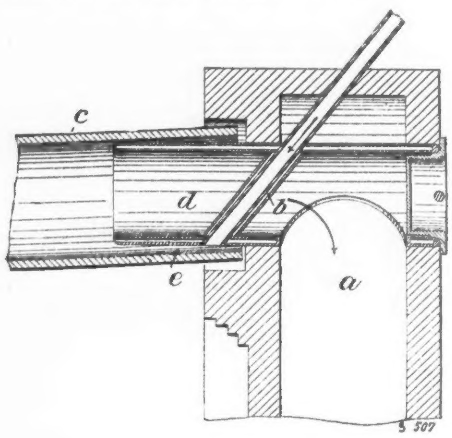


Fig. 1. A tube is inserted in the rotary kiln head

gases, so that they leave at a greater velocity and as a result carry more dust. This drawback has been overcome by the arrangement shown in Fig. 2. In order to prevent

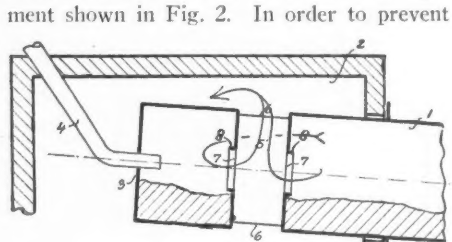


Fig. 2. Side view of the charging tube

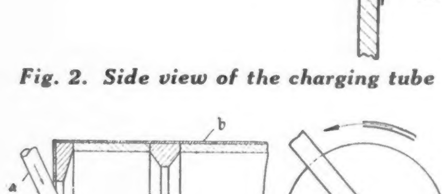


Fig. 3. The charging tube dips into the mix

entrance of cold air while charging the kiln, a charging tube is provided which dips into the charged mix as shown in Fig. 3.

In order to assure a sufficiently deep layer of mix at the charging end of the kiln, the mix may be charged direct from mix bins to the rotary kiln by means of a screw conveyor as shown in Fig. 4. The screw does not reach quite to the end of the charging tube, so as to protect it from the fire.

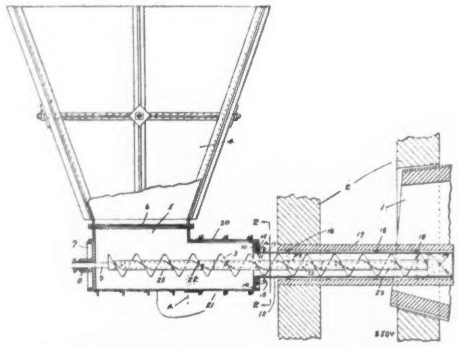


Fig. 4. Screw conveyor for charging mix directly from mix bins to the rotary kiln

Since the high temperature at the upper kiln end is unfavorable to the forming of lumps, the feed has been mixed with tar, pressed into bricks, surfaced with tar and then fired, but this process was expensive for fuel and for making the bricks.

In another process, the raw mix is passed through a pair of adjustable rollers, leaving them in the form of a thread which breaks or is cut into handy pieces before entering the kiln. As shown in Fig. 5, this process is used also in charging shaft kilns. A little water may be added to these bricks before they enter the burner.

In another process the kiln section in which the mix forms into lumps is separated from the actual kiln so that the hot kiln gases do not affect them. For example, in the diagram shown in Fig. 6, the raw mix wetted in a screw mixer enters into a rotary drum by way of a slide into which more dry raw mix is supplied. As the drum rotates, the damp mix forms lumps to which the added dry mix starts to adhere. As the lumps pass through the drum, they become harder due to impinging upon each other. Lumps of any desirable size may be made by adding more water and more dry mix. The material passes from the rotary drums into a conveyor which distributes it to the individual rotary or shaft kilns. The lumps are as a rule of pea size to hazel-nut size. If a certain raw material does not lump so completely, a screen may be installed beneath the rotary drum end to screen out the fines and return them to the drum.

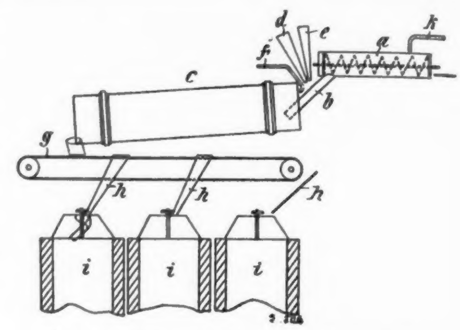


Fig. 6. Raw mix entering into rotary drum by way of slide

In a slightly different process the screw mixer is eliminated and the dry raw mix is charged direct to the rotary drum in measured quantities. A pipe provided with small openings extends the full length of the drum. Water drips continually from the pipe on the rotated dry mix. The drops of water are each surrounded with dry mix and thus form the basis of a lump. These lumps in-

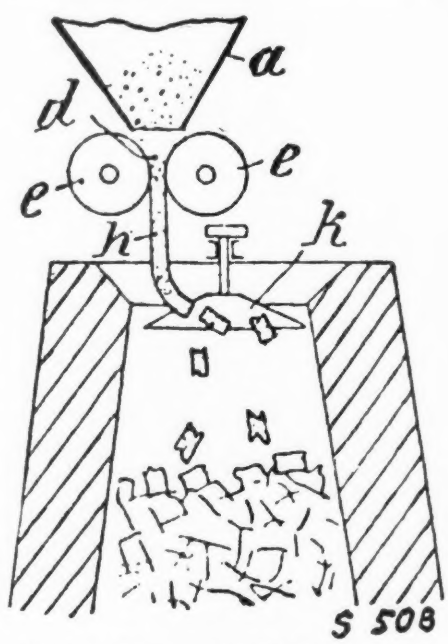


Fig. 5. Process by which raw mix is passed through a pair of adjustable rollers

crease in size as they pass through the drum. As a rule another drum is attached in series which is not charged with water, but is used only to better roll the lumps. The spray pipe is located slightly off center of the drum. To assure uniform burning material, the fines and the fine lumps should be screened out.—*Tonindustrie-Zeitung* (1929) **53**, 70, pp. 1263-1265.

When charging slurry of 40% moisture content to the rotary cement kiln, consider-

able fuel is needed to evaporate the water in the kiln. It is the purpose of E. Schirm in another article to show means of reducing the excessive fuel consumption, while limiting his discussion to methods employed in charging the kiln. He traces the development of the methods of charging the rotary cement kiln and goes into detail relative to the illustrations shown.

According to the German Patent No. 425,-846 (see Fig. 7), the slurry is charged by

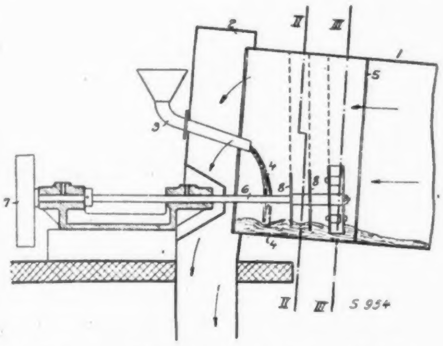


Fig. 9. The slurry is diffused by means of a rotating disc

way of several nozzles provided in the kiln; *a* is the kiln lining, *b* the diffusion nozzles, *c* the slurry tube which can rotate in the stuffing box *d*.

According to the German Patent 421,551 (see Fig. 8), the slurry is charged from the

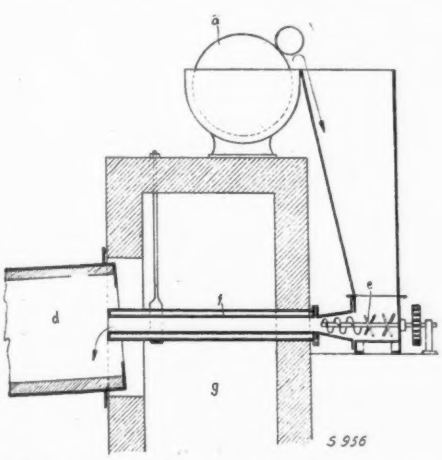


Fig. 11. Arrangement by which slurry is fed on the heavy slurry dry process

burner side; *a* is the kiln lining, *b* the pulverized coal nozzle, *c* the slurry nozzle, *d* the control.

According to the British Patent No. 284,-276 (see Fig. 9), the slurry is diffused by means of a rotating disc; *1* is the kiln lining,

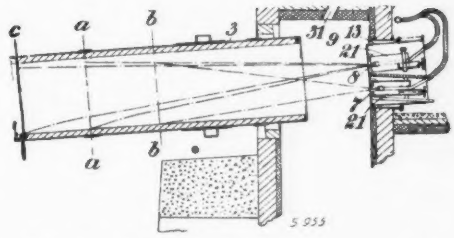


Fig. 10. Supplying slurry by means of nozzles in kiln head

2 the kiln head, *3* the slurry delivery, *4* the slurry jet, *5* the partition ring, *6* the shaft, *7* the drive, *8* the centrifugal discs.

According to the German Patent No. 478,-632 (see Fig. 10), the slurry is supplied by way of several nozzles in the kiln head; *3* is the kiln lining, *5* the rear side of the kiln head, *7* and *8* the slurry nozzles, *13* the nozzle chamber, *21* the nozzle head, *31* the emergency nozzle supply.

According to the German Patent No. 426,-700 (see Fig. 11), the slurry is fed on the

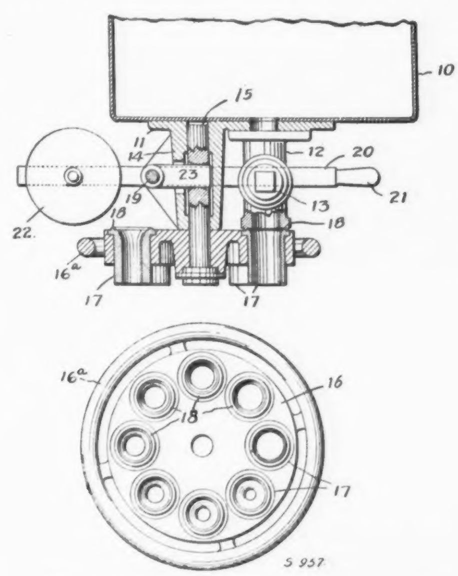


Fig. 12. American patented process for charging rotary cement kilns

heavy slurry dry process; *a* is the centrifugal drum, *d* the rotary kiln, *e* the press, *f* the supply duct, *g* the waste gas collector.

Fig. 12 illustrates the United States Patent No. 1,640,528 for charging rotary cement kilns.—*Tonindustrie-Zeitung* (1930) **54**, 1, pp. 8-11.

Germans Plan Lime Museum. A lime museum is to be provided in October at Ruedersdorf near Berlin, which will offer a geological, technical and economical (commercial)insight into the history of the lime industry around Ruedersdorf.—*Tonindustrie-Zeitung* (1930) **54**, 39, p. 1663.

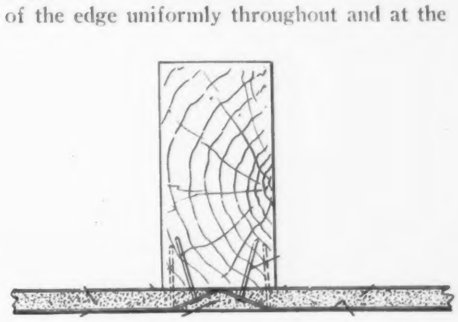
Speed Regulation of Rotary Cement Kilns. E. Auerbach discusses four types of electric motor drives, which may be used to reduce the speed of rotary kilns to one-half. He shows also how to determine what type of electric motor to select as the most economical upon the basis of a chart and other data supplied by the German General Electric Co.—*Tonindustrie-Zeitung* (1930) **54**, 38, pp. 635-637.

Use of Bauxite in Portland Cement. J. Deforge discusses an example of utilization of bauxite in the manufacture of portland cement. Chemical compositions are also given, and a wet process cement plant using bauxite as ingredient is described and illustrated.—*Revue des Materiaux de Construction et de Travaux Publics* (1930) 244, pp. 11-13; 245, pp. 64-67.

Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Superintendent of Documents, Government Printing Office, Washington, for each patent desired.

Plaster Board Construction. It is an object of this invention to provide a plaster wallboard, without binding or covering the edge, that will maintain consistent thickness of the edge uniformly throughout and at the

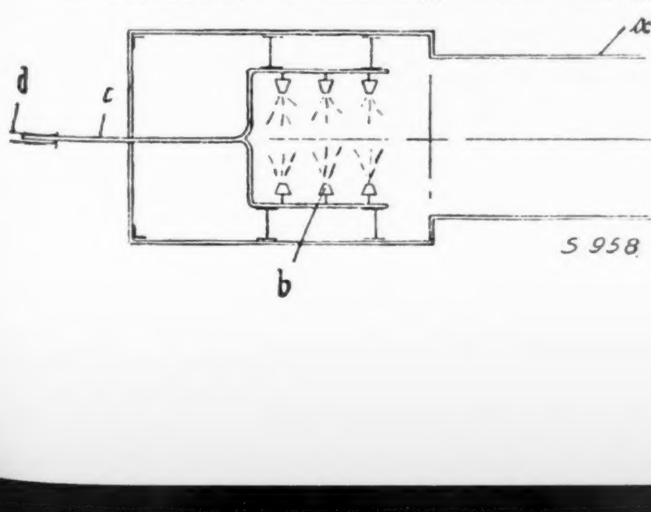


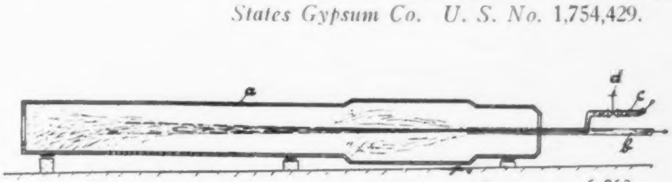
Construction of wallboard

same time provide a sufficient space between adjacent boards when secured in place upon the wall for the "crack filler" to bond and cover the joint without the formation of cracks between the boards.

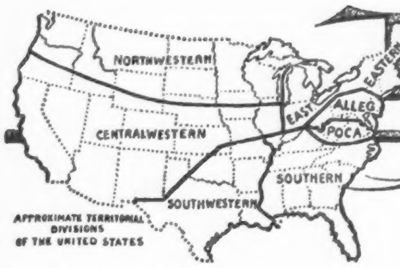
The accompanying cut shows how the patentee proposes to construct the wallboard covered by the patent.

The author of the patent also describes the machinery intended to manufacture this board.—*O. M. Knode, assignor to United States Gypsum Co. U. S. No.* 1,754,429.





Left—Fig. 7 shows how slurry is charged by way of several nozzles in the kiln. Right—Fig. 8 shows how slurry is charged from the burner side



Traffic and Transportation

Car Loadings of Sand and Gravel, Stone and Limestone Flux

THE following are the weekly car loadings of sand and gravel, crushed stone and limestone flux (by railroad districts) as reported by the Car Service Division, American Railway Association, Washington, D. C.:

CAR LOADINGS OF SAND, GRAVEL, STONE AND LIMESTONE FLUX

District	Limestone Flux Week ended May 31	Limestone Flux Week ended June 7	Sand, Stone and Gravel Week ended May 31	Sand, Stone and Gravel Week ended June 7
Eastern	3,438	3,754	11,085	12,882
Allegheny	3,070	3,294	7,516	8,797
Pocahontas	778	691	1,659	1,481
Southern	677	687	9,066	8,630
Northwestern	1,392	1,382	7,124	7,839
Central Western	419	430	13,225	13,945
Southwestern	582	479	7,835	7,426
Total	10,356	10,717	57,510	61,000

COMPARATIVE TOTAL LOADINGS, BY DISTRICTS, 1929 AND 1930

District	Limestone Flux 1929 Period to date June 8	Limestone Flux 1930 Period to date June 7	Sand, Stone and Gravel 1929 Period to date June 8	Sand, Stone and Gravel 1930 Period to date June 7
Eastern	66,877	59,709	144,279	116,671
Allegheny	73,113	57,951	104,239	103,512
Pocahontas	7,539	8,548	14,781	21,087
Southern	11,030	15,203	178,942	163,110
Northwestern	20,880	18,561	82,651	69,137
Central Western	11,844	10,863	177,032	187,426
Southwestern	10,070	9,568	124,215	126,815
Total	201,353	180,403	826,139	787,758

COMPARATIVE TOTAL LOADINGS 1929 AND 1930

	1929	***1930***
Limestone flux	***201,353***	***180,403***
Sand, stone, gravel	***826,139***	***787,758***

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week beginning June 28:

CENTRAL FREIGHT ASSOCIATION DOCKET

25290. To establish on **sand and gravel**, carloads (See Note 3), Pittsburgh, Allegheny (Pittsburgh, North Side) and Junction Transfer (33rd St. Station), Penn., to Montour R. R. stations, rates as shown in Exhibit A attached.

Route—B. & O. R. R., Snowden, Montour R. R. Present—No commodity rates published.

EXHIBIT "A"

Rates on Sand and Gravel From Pittsburgh, Penn. (Rates in cents per 2000 lb.)

To Montour R. R. Stas. in. Penn.	Rate Pres.	Rate Prop.	To Montour R. R. Stas. in. Penn.	Rate Pres.	Rate Prop.
Montour Jct.	60	80	Hendersonville	60	80
Beaver Road	60	80	Hyland	60	80
Scott	60	80	Hills	....	80
Cliff Mine	60	80	McMurray	80	80
Imperial	60	80	Library	80	80
North Star	70	80	Snowden, Penn., B. & O. Montour Junction. Present rate via B. & O., 80c.		
Boggs	60	80			
Champion	60	80			
McAdams	60	80			
McDonald	60	80			
Southview	60	80	Jewell	....	80
Cowden	60	80	Brightwood	80	80
Muse	70	80	Solida	....	80
National	....	80	Mifflin Jct.	....	80

25291. To establish on **sand and gravel**, carloads (See Note 3), Peru, Ind., to Crawfordsville, Ind., rate of 100c per ton of 2000 lb. Route—Via Hoovers, Ind., and P. R R. Present—14c.

25296. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and **gravel**, carloads (See Note 3), from Cleveland, O., to Jefferson, O., rate of 90c per net ton. Present—$1 per net ton.

25297. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass grinding or polishing, loam, molding or silica) and **gravel**, carloads (See Note 3), Hugo, O., to Ravenna and Suffield, O., rate of 80c per net ton. Persent—9½c via Erie R. R. and $1.10 per net ton via W. & L. E. Ry.

25299. To establish on **crushed stone**, carloads (See Note 3), Carey and McVittys, O., to Toledo, O., rate of 60c per net ton. Present—70c per net ton.

25300. To establish on **crushed stone and crushed stone screenings**, carloads (See Note 3), Apex, O., to points in Ohio, rates as shown in Exhibit B attached. Present—As shown in Exhibit B attached.

EXHIBIT "B"

Crushed Stone and Crushed Stone Screenings From Apex, O.

To Erie R. R. (Route via Braceville, O.)	Rate Pres.	Rate Prop.
Akron, O.	105	100
Barberton, O.	115	100
Carlott, O.	115	105
Cleveland, O.	115	105
Kent, O.	105	100
South Akron, O.	105	100
Talmadge, O.	105	100
W. & L. E. (Route via Minerva O.)		
Bedford, O.	105	100
Cleveland, O.	115	105
Falls Junction, O.	105	100
N. Y. C. R. R. (Route direct.)		
Cleveland, O.	320	105
Youngstown, O.	340	100
P. R. R. (Route via Alliance, O.)		
Canton, O.	260	85

Note 1—Minimum weight marked capacity of car.

Note 2—Minimum weight 90% of marked capacity of car.

Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.

25304. To establish on **sand** (other than blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) **or gravel and crushed stone**, carloads (See Note 3), Buffalo, N. Y., to Blasdell, Eden Center, Eden Valley, Hamburg and Water Valley, N. Y., rate of 60c per ton of 2000 lb. Present rate—75c per ton of 2000 lb. on sand, gravel and crushed stone.

25310. To establish rate of $2.62 per 2000 lb. on **processed sand** and $2.20 per 2000 lb. on **crude sand**, carloads (See Note 3), Ottawa, Ill., district to Dayton and Moraine, O. Present rate—$2.90 per ton 2000 lb.

25313. To establish on **crushed stone** (See Note 3), carloads, Huntington, Ind. Rates (in cents per ton of 2,000 lb.):

To Ohio points.	Prop.	Pres.	To Ohio points.	Prop.	Pres.
Alvordton	100	110	Elmira	95	110
Baldwin	95	107	Kunkle	100	105
Blakesley	95	99	Montpelier	95	105
Eden	100	110	West Unity	95	110

Route—Via Wabash Ry. direct.

25340. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) and **gravel**, carloads (See Note 3).

From Attica, Ind.

To—	(Cts. per net ton) Prop.	Pres.
Markham, Ill.	101	113
Chapin, Ill.	101	113

From Lafayette, Ind.

To—	(Cts. per net ton) Prop.	Pres.
Markham, Ill.	109	121
Chapin, Ill.	109	121

Route—Via Wabash Ry. direct.

Tariff authority—Wabash Ry. No. F16505, I. C. C. 6323.

25347. To establish on **stone, crushed**, in bulk, in open-top cars, **stone screenings**, in bulk, in open-top cars, in straight or mixed carloads; **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) **and gravel**, carloads (See Note 3), from Lake Ciecott and Kenneth, Ind., to Oxford, Ind., rate of 95c per net ton. Present rate, classification basis.

25348. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding and silica) **and gravel**, carloads (See Note 3), from Columbus, O., to Queen Shoals, W. Va., rate of $1.80 per net ton. Route—Via N. Y. C.-B. & O. R. Rs. Present rate, 30½.

25354. To establish on **limestone, agricultural** (not ground or pulverized), in bulk, in open-top cars; **stone, crushed**, in bulk, in open-top cars, and **stone screenings**, in bulk, in open-top cars, in straight or mixed carloads (See Note 3), from Maple Grove, O., to points in Michigan and Indiana, rates as illustrated in Exhibit "A" attached. Present rates, as illustrated in Exhibit "A" attached.

EXHIBIT "A" (REPRESENTATIVE POINTS)

(Rates in cents per net ton)

(Michigan Destinations) C. C. C. & St. L. Ry.:	Miles	Pres.	Prop.
Eau Claire—Via P. R. R., Warsaw, Ind., C. C. C. & St. L.	261.2	420	175
Cincinnati Northern Ry.			
Rollin—Via P. R. R., Van Wert, O., C. N. Ry.	202.5	300	155
D. T. & I. R. R.			
Page—Via P. R. R., Toledo, D. T. & I. R. R.	141.4	270	125
Sand Creek—Via P. R. R., Toledo, D. T. & I. R. R.	135.4	280	125
Grand Trunk Ry.			
Pomeroy—Via P. R. R., Vicksburg, Mich., G. T. Ry.	203.0	370	155
Edwardsburg—Via P. R. R., South Bend, Ind., G. T. Ry.	230.8	400	165
Michigan Central R. R.			
New Buffalo—Via P. R. R., Toledo, M. C. R. R.	302.4	420	195
St. Joseph—Via P. R. R., Toledo, M. C. R. R.	311.0	450	195
New York Central R. R.			
Weston—Via P. R. R., Toledo, N. Y. C. R. R.	70.4	280	97
Jasper—Via P. R. R., Toledo, N. Y. C. R. R.	66.8	280	97
Pere Marquette Ry.			
New Buffalo—Via P. R. R., Hanna, Ind., P. M. Ry.	247.6	420	165
Riverside—Via P. R. R., Toledo, P. M. Ry.	298.6	430	185
Toledo & Western Ry.			
Harrison—Via P. R. R., Toledo, T. & W. Ry.	62.3	270	97
Pennsylvania R. R.			
Wayland—Via P. R. R. direct.	235.5	176	165
Wabash Ry.			
North Morenci—Via P. R. R., Toledo. Wabash Ry.	100.8	280	115
Seneca—Via P. R. R., Toledo, Wabash Ry.	97.8	280	107
(Indiana Destinations)			
Baltimore & Ohio R. R.			
Wawasee, Ind.—Via P. R. R., Tiffin, O., B. & O. R. R.	141.5	340	125
C. C. C. & St. L. Ry.			
Leesburg—Via P. R. R., Warsaw, Ind., C. C. C. & St. L.	176.1	360	145
Grand Trunk Ry.			
Crumstown—Via P. R. R., So. Bend, G. T. Ry.	226.2	400	165
Michigan Central R. R.			
Notre Dame—Via P. R. R., Toledo, M. C. R. R.	284.5	390	185
N. J. & I. R. R.			
Sweeneys—Via P. R. R., Toledo, Wabash Ry., Pine, Ind.	185.8	390	165
New York Central R. R.			
Academie—Via P. R. R., Toledo, N. Y. C. R. R.	132.9	320	125
Pennsylvinia R. R.			
Auburn—Via P. R. R. direct.	116.4	300	115
Wabash Ry.			
Hamilton—Via P. R. R., Toledo, Wabash Ry.	108.6	330	115

25355. To establish on **limestone, agricultural** (not ground or pulverized), in bulk, in open-top cars; **stone, crushed**, in bulk, in open-top cars, and **stone screenings**, in bulk, in open-top cars, in straight or mixed carloads (See Note 3), from

Maple Grove, O., to Beech, Mich., rate of $1.07 per net ton. Route—P. R. R., Toledo, O., P. M. Ry. Present rate, classification basis.

25361. To establish on **spent or refuse grinding sand,** in open-top cars, carloads (See Note 3), from Butler, Penn., to Pittsburgh, Penn. (B. & O. R. R.), rate of 80c per ton of 2000 lb. Present rate, $1.05 per 2000 lb.

25363. To establish on **crushed stone,** carloads (See Note 3), from Muncie, Ind., to C. & O. Ry. (Chicago Div. stations), in cents per 2000 lb.:

To	Prop.	To	Prop.
Peru, Ind.	80	Boston, Ind.	75
Santa Fe, Ind.	75	Witts, Ind.	80
Amboy, Ind.	75	Kitchell, Ind.	80
Converse, Ind.	75	Cottage Grove, Ind.	80
Sweetser, Ind.	70	Bath, Ind.	85
Marion, Ind.	65	Raymond, Ind.	85
Jonesboro-		Peoria, Ind.	85
Gas City, Ind.	65	Newkirk, O.	90
Gaston, Ind.	60	Okeana, O.	90
Medford, Ind.	60	Shandon, O.	95
Blountsville, Ind.	60	Fernald, O.	95
Losantville, Ind.	60	Miami, O.	95
Economy, Ind.	65	Bridgetown, O.	100
Williamsburg, Ind.	65	Cheviot, O.	100
Webster, Ind.	70	Cincinnati, O.	105
Richmond, Ind.	75		

Present rates, sixth class.

25364. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) **and gravel,** carloads (See Note 3), from Wolcottville, Ind.

To	Pres.	Prop.
Corunna, Ind.	85	80
Waterloo, Ind.	85	80
Auburn Junction, Ind.	107	80
Carrolls Crossing, Ind.	85	80

Route—P. R. R., Kendallville, N. Y. C. R. R.

25565. To establish on **agricultural limestone,** in bulk, in open cars, **crushed stone,** in bulk, in open cars, **stone, rip rap,** in open cars, **stone screenings,** in bulk, in open cars, and **stone tailings,** in bulk, in open cars, carloads (See Note 3), from Greencastle and Limedale, Ind., to points in Indiana.

To	Pres.	Prop.	To	Pres.	Prop.
Logansport	120	105	Marion	(a)	120
Bunker Hill	(a)	110	Upland	(a)	125
Loree	(a)	110	Hartford City	(a)	125
Converse	(a)	115	Mill Grove	(a)	125
Mier	(a)	115	Dunkirk	(a)	130
Gas City	(a)	120	Powers	(a)	130

(a) Classification basis.

25366. To establish on **crushed stone,** carloads (See Note 3), from Keeport, Ind.

Via Wabash Ry. direct:

To	Prop.	Pres.
Clymers, Ind.	65	69
Burrows, Ind.	65	69
Rockfield, Ind.	65	70
Delphi, Ind.	65	70

(Rates in cents per ton of 2000 lb.

Via Wabash Ry., Delphi, Ind., and C. I. & L. Ry.:

Oakley, Ind.	80	115

Rate to Kirklin, Ind., applicable through use of Item 5 of Wabash Ry. Tariff I. C. C. No. 6431.

25368. To establish on **crushed stone,** carloads (See Note 3), from Monon, Ind., to stations on the Penna. R. R., rates as shown below:

To Penna. R. R. Stations.	Pres.	Prop.
LeRoy, Ind.	92	90
Prairie View, Ind.	92	90
Crown Point, Ind.	92	90
Scherville, Ind.	92	95
Lansing, Ill.	92	95
Bernice, Ill.	92	95

25390. To establish on **rubble stone,** carloads in open-top equipment (See Note 3), from Milwaukee, Wis. (via car ferry across Lake Michigan), to Roscommon, Mich., proportional commodity rate of $2.12 per net ton. Present rate, 24½c, minimum weight 40,000 lb.

25391. To establish on **crushed stone and screenings, including crushed limestone and limestone screenings,** carloads (See Note 3), Hillsville-Walford, Penn., to Carol, Penn., rate of $1, and to Limestone, Penn., rate of $1.10 per 2000 lb. Present rates—To Carol, Penn., $1.10, and to Limestone, Penn., $1.20 per 2000 lb.

25399. To establish on **spent or refuse grinding sand,** in open-top cars carloads (See Note 3), Butler, Penn., to Walford, Penn., rate of $1 per ton of 2000 lb. Route—Via B. & O. R. R., New Castle Jct., Penn., P. & L. E. R. R. Present rate, 13c.

25405. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) **and gravel,** carloads (See Note 3), Hynds, Ind., to Indianapolis, Ind., rate of 70c per net ton. Route—Via P. R. R. direct. Present rate, classification basis.

25423. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica) **and gravel,** carloads (See Note 3), from Wolcottville, Ind., to Three Rivers, Mich., rate of 82c per ton of 2000 lb. Present rate, classification basis.

25438. To establish on **sand** (except glass sand) **and gravel,** straight or mixed carloads (See Note 3), R. A. Junction and Sturm and Dillard Siding, O., to Boomer and Boncar, W. Va., 155c per ton of 2000 lb. Route—Via C. & O. Ry., Charleston, W. Va., N. Y. C. R. R. Present rate, sixth class.

25439. To establish on **sand, viz., glass, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding or silica,** carloads (See Note 3), Staunton, Ind., to Terre Haute, Ind., 88c per ton of 2000 lb. Present rate, classification basis.

25440. To establish on **sand and gravel,** carloads (See Note 3), Columbus, O., to Dover, O., rate of 105c per ton of 2000 lb. Present rate, 16c.

25451. To establish on **sand and gravel,** carloads (See Note 3), Earlville, O., to Fairlawn and Copley, O., rate of 70c per net ton. Route—P. R. R., Akron, O., and A. C. & Y. Ry. Present rate, $1.20 per net ton.

TRUNK LINE ASSOCIATION DOCKET

23878. **Unburned ground limestone,** carloads, minimum weight 50,000 lb., from West Athens, N. Y., to Kent, Conn., $3.20 per net ton. (Present rate, 20½c per 100 lb.) Reason—Proposed rate is comparable with rate from Montrose, N. Y., to Providence, R. I., Willimantic and New London, Conn.

23886. **Sand, common or building** (not blast, engine, fire, foundry, glass, molding or silica) **and gravel,** carloads (See Note 2), from Attica, N. Y., to Clarence, N. Y., 75c per net ton. (Present rate, 83c per net ton.) Reason—Proposed rate is comparable with rates on like commodities for like distances, services and conditions within the same general territory.

23899. **Sand** (other than blast, engine, foundry, molding, glass, silica, quartz or silex) carloads (See Note 2), from Texas, Md., to Lancaster, Penn., $1.15 per net ton. Present rate—$1.50 per net ton. Reason—Proposed rate is comparable with rates from northeast and Philadelphia, Penn.

23904. To establish the following switching charges:

Commodity—**Crushed stone,** carloads, also empty cars, from one location on track serving plant of American Lime and Stone Co., Union Furnace, Penn., to another location on track serving same plant. (1) $3.15 per car, (2) $3.15 per car.

Route—Pennsylvania railroad.

(1) Applicable only on traffic for subsequent movement in same car which has paid or will pay a road haul rate, or on traffic which will pay or has paid a road haul rate moved from one siding to another siding with the same switching limits.

(2) Applicable on traffic other than as covered by column (1).

23911. To establish commodity rates on **molding sand,** carloads (See Note 2), from Round Lake, Ballston, Lake, Ballston Spa, Saratoga Springs and Gansevoort, N. Y., to all destinations in C. F. A. territory as described in Agent Curlett's I. C. C. A265 on basis of 1½c per 100 lb. higher than published from Albany Group points in Agent Curlett's I. C. C. A265. Reason—To place rates on uniform basis to all destinations.

M1456. **Crushed stone,** carloads (See Note 2), from Bowden and Faulkner, W. Va., to Nethken, Gorman, Md., Hoffman Siding and Georgian, W. Va., $1 per net ton. (Present rate, $1.15 per net ton.) Reason—Proposed rate is comparable with rates on like commodities for like distances, services and conditions.

23928. **Sand and gravel,** carloads (See Note 2), from Kenvil, N. J., to Hauto and Nesquehoning, Penn., $1.30 per net ton. Reason—Proposed rate is comparable with rates on like commodities for like distances, services and conditions.

23931. **Sand and gravel,** carloads, other than blast, engine, foundry, glass, molding or silica (See Note 2), from Alfred, N. Y., to Genesee, Penn., $1 per net ton. (Present rate, $1.30 per net ton.) Reason—To meet motor truck competition.

23932. **Sand** (other than blast, engine, foundry, glass, molding, quartz, silica or silex) **and gravel,** carloads (See Note 2), from Haven, N. Y., to Monticello, N. Y., 60c per net ton. (Present rate, 70c per net ton.) Reason—To meet motor truck competition.

23933. **Gravel and sand** (other than blast, engine, fire, glass, molding or foundry, quartz, silex and silica), carloads (See Note 2), from Port Covington (Baltimore), Md., to Hampstead, Md., 90c net net ton. (Present rate, $1.05 per net ton.) Reason—Proposed rate is comparable with rates to Westminster, New Windsor, Union Bridge, Md., etc.

23935. To increase rate of 85c to 90c per net ton on **crushed stone,** carloads (See Note 2), from Northampton, Penn., Tamaqua, Lansford and Coaldale, Penn. Reason—Proposed rate is comparable with rate from the Nazareth district.

23957. **Phosphate rock, crude, lump, pulverized, dissolved or ground, in bulk,** carloads, minimum weight 40,000 lb., from Baltimore, Md., to Paper Mill to Benton, Penn., 19c per 100 lb. Reason—Proposed rate is same as now applicable on fertilizer compound from and to same points.

23958. To establish the same rates on **unburned ground limestone,** carloads, minimum weight 50,000 lb., from Natural Bridge, N. Y., on the same basis as are now in effect on crushed stone from Ogdensburg, N. Y., to destinations in C. F. A. territory as published in Agent Curlett's I. C. C. A265. Reason—Proposed rates are comparable with rates from Albany, New Berlin and Syracuse rate points.

23961. **Crushed stone** (See Note 2), from White Haven, Penn., to Ringtown and Krebs, Penn., $1.25 per net ton. (Present rate, $1.40 per net ton.) Reason—Proposed rate is comparable with rates to Mt. Carmel, Brandonville and Shenandoah.

23967. **Crushed stone,** carloads (See Note 2), from Steelton, Penn. (proposed rates in cents per 2000 lb.):

To	Prop.	Pres.
Turbottsville, Penn.	110	140
Ottawa, Penn.	110	22½
Strawberry Ridge, Penn.	110	22½
Jerseytown, Penn.	110	22½
Buckhorn, Penn.	120	22½
Berwick, Penn.	120	22½

Reason—Proposed rates are fairly comparable with rates on like commodities for like distances, services and conditions.

M-1461. **Sand, common or building** (not blast, engine, fire, foundry, glass, molding or silica) **and gravel,** carloads (See Note 2), from Ballina, N. Y., to Martisco, N. Y. (will apply only on traffic destined to points on the Marcellus and Otisco Lake R. R.), 70c per net ton. Present rate, 83c per net ton.) Reason—To meet motor truck competition.

M-1462. **Stone, natural** (other than bituminous asphalt rock), **crushed,** carloads (See Note 2), from Auburn, N. Y., to Martisco, N. Y. (will apply only on traffic destined to stations on the Marcellus and Otisco Lake R. R.), 60c per net ton. (Present rate 75c per net ton.) Reason—To meet motor truck competition.

M-1463. **Crushed stone,** carloads (See Note 2), from Blissville Docke, L. I., N. Y., to Rockville Center, L. I., N. Y., 85c per net ton. (Present rate $1 per net ton.) Reason—To meet motor truck competition.

M-1464. **Sand and gravel,** other than blast, engine, foundry, glass, molding or silica, carloads (See Note 2), from Alfred, N. Y., to Shongo, N. Y., $1 per net ton.

M-1465. (A) **Sand,** other than blast, engine, fire, glass, foundry, molding, quartz, silex and silica, carloads, and (B) **Sand, blast, engine, fire, glass, foundry, molding, quartz, silex and silica, and gravel,** carloads (See Note 2), from Palmerton Penn., to New Village, N. J., (A) $1.10 and (B) $1.20 per net ton. Reason—Proposed rate is comparable with rates from Bethlehem, Penn., to Dover, Penn., Newton, Andover, N. J., etc.

M-1469. **Crushed stone,** carloads (See Note 2), from Le Roy, N. Y., to Pine City, N. Y., Seeley Creek, N. Y., and Millerton, Penn., $1.25 per net ton. Reason—Proposed rate is comparable with rates on like commodities for like distances, services and conditions.

SOUTHERN FREIGHT ASSOCIATION DOCKET

50894. **Crushed and broken stone,** from Yellow Rock, Ky., to O. & K. Ry. stations. It is proposed to establish the following through rates on: Crushed and broken stone, carloads (See Note 3), from Yellow Rock, Ky.: To stations Cane Creek to Wilhurst, Ky., 95c; stations Hampton to Stacy Fork, Ky., inc., 105c; stations Wells to Licking River, Ky., inc., 115c per net ton. The proposed rates to expire four months from the date they become effective.

50901. **Sand, gravel, etc.,** from Montgomery, Ala., to Douglas, Ga. Present rate, 150c per net ton. Proposed rate on sand, gravel, etc., as provided in Item 5, page 55, Agent Glenn's I. C. C. A655, from Montgomery, Ala., to Douglas, Ga., 160c per net ton. Proposed in order to place the rate on the proper basis.

NEW ENGLAND FREIGHT ASSOCIATION DOCKET

19847. **Crushed stone (trap rock),** in bulk in gondola or other open-top cars (See Note 3), from Westfield, Mass., to Saugerties, N. Y. Present rate, 18½c; proposed, $1.60 per net ton. Reason—To establish rates comparable with existing rates for similar distances.

19947. **Common sand and gravel,** minimum weight 50 net tons, from Scarboro Beach, Me., to Portland, Me. Present, 60 net tons on sand and run of bank gravel and 70 net tons on screened or crushed gravel; proposed, 50 net tons. Reason—To meet motor truck competition.

20031. **Crushed stone** (trap rock), in bulk in gondola or other open top cars (See Note 3), from Westfield, Mass. Proposed:

Crushed stone to Kingston, N. Y., $1.60 per net ton; Walden, $1.70 per net ton.

Reason—To establish rates comparable with existing rates for similar distances.

Wallace Stone Co., Michigan, Preparing for Lake Shipments

COMPLETION of the half million dollar project for shipping Bay Port stone by boat is expected soon, Robert Wallace, of the Wallace Stone Co., in charge of the works, announced recently.

Crews of men are working day and night to finish the grade and tunnel. A track has been constructed from the quarry to Wild Fowl bay, a distance of about two and a half miles. As the railroad nears the bay at a point about a mile and a half east of Bay Port, the grade increases until it is 35 ft. high.

A concrete tunnel 210 ft. long, 8 ft. high and 8 ft. wide has been constructed where a conveyor belt 30 in. in width will be installed to carry the crushed stone to the boats. The tunnel is at the east of the track. Several stone bins are built above the tunnel where the stone will be unloaded from the cars into the conveyor system.

A high wall is at the end of the grade, which is about 200 ft. from the bay. A dredging outfit is constructing a channel from a distance of two miles in the bay to the end of the grade. Boats will dock at the north end of the tunnel.—*Bad Axe* (Mich.) *Tribune.*

Water transportation of stone and sand from the Wallace Stone Co. properties at Bay Port is being undertaken through the organization of the Bay Port Transportation Co., which was announced recently.

The company has a steel barge and a tug boat to haul it and it is planned to deliver stone and foundry sand by this means to Saginaw, Bay City, Port Huron, Harbor Beach and other lake ports. Later the company plans to purchase a ship for this purpose.

William H. Wallace is president of the new company which is capitalized at $20,000. George B. Morley is vice-president, Robert N. Wallace, secretary, and William Wallace, Jr., treasurer.—*Saginaw* (Mich.) *News.*

Baker Gravel Company, Indiana, Expands

THE BAKER GRAVEL CO., for a good many years one of the growing concerns of Hamilton (Ind.) county and still going good notwithstanding present business conditions, has plans well under way to spend between $40,000 and $50,000 on improvements during the coming season. If the plans as now mapped out develop as expected the job will start about the middle of July.

The other day the company entered into a contract lease with the Ball Brothers for 24 acres of land which extends from the south edge of the Baker property (formerly the old baseball grounds) on south to the traction line. All of the improvements will be made on this property. None of the old gravel bins will be used. They have been built for about 15 years and the company does not believe it would pay to move them. Five new bins will be erected, according to present plans, and if any of the old machinery cannot be used to an advantage in the new location, it will be replaced with new. Just how much of this kind of new equipment will be necessary cannot be told at this time, but will have to be determined when the removal process starts. Other changes will be made but many of them cannot be foretold at the present time for the reason it is not known exactly what will be needed before the actual work starts.

The Baker brothers report good business. They already have a number of orders for gravel and are expecting a good many more before the season is very far advanced.

The company is composed of Edgar Baker, formerly county surveyor, and Earl S. Baker, former cashier of the Citizens State Bank. They are energetic but conservative business men who are succeeding. The company was originally organized by Ed Baker. —*Noblesville* (Ind.) *Ledger.*

Ontario Mineral Resources

IN A GENERAL REVIEW of the nonmetallic mineral resources of the province of Ontario, Canada, W. S. Dyer, Ontario Department of Mines, shows that the production of nonmetallic minerals in Ontario in 1928 was valued at $28,816,119, of which $14,815,814 represented structural materials and $6,177,664 clay products. The following products are discussed: abrasives, clay, diatomite, gypsum, lignite, limestone, natural gas, petroleum, salt and silica sand.

Hydration of Calcined Gypsum

A RECENT issue of *Industrial and Engineering Chemistry* contained a paper on the hydration and setting of gypsum plaster by W. C. Hansen of the American Cyanamid Co. and Structural Gypsum Corp., Linden, N. J. The study was made to determine why soluble materials, when added to calcined gypsum stucco, either accelerate or retard the setting of the material.

From a study of time-temperature curves obtained from the hydrations of calcined gypsum in various solutions it appeared that the controlling factor in the setting was the rate at which precipitation took place from the paste. A study of the rate at which gypsum precipitated from carefully mixed solutions of calcium nitrate and ammonium sulphate to which had been added other salts showed that foreign salts markedly affect the rate at which gypsum precipitates from its supersaturated solution. This effect of foreign materials upon the rate of precipitation of gypsum from its supersaturated solutions appears to explain the ability of foreign materials to accelerate or retard the setting of calcined gypsum pastes.

Canada Gypsum and Lime Manufacturer May Build in England

POSSIBILITY of Canadian manufacturing interests entering the British field and establishing a plant in England is seen in the departure for Europe recently of R. E. Haire, president of Gypsum Lime and Alabastine, Canada, Ltd., Paris, Ont., head of a nationwide organization, with mills and mines from the Atlantic to the Pacific, and with export business with every continent on the globe.

Mr. Haire admitted that while in England he intended to survey the market abroad with a view to deciding whether or not erection of a gypsum products plant there within the next year or two would be advisable.

"Only a few weeks ago," Mr. Haire said, "we held a trade conference in London, to which we invited sales representatives from a large section of the continent, as well as from the British Isles. The results were most satisfactory and indicated that the field for the sale of these Canadian manufactures abroad should be capable of considerable expansion. J. F. Cameron has just returned with most encouraging reports and the matter of opening a London office, with a Canadian executive in charge, is one that we expect to settle in the immediate future.

"Export is an aspect of Canadian manufacture which is obviously destined to be of greatly increased importance to the Dominion's industry in general and a vital factor in national prosperity," he said. "This is a very opportune time for the Canadian firm to lay sound foundations for a great increase in the volume of its foreign trade."—*Toronto* (Ont.) *Star.*

Set New Mark in Constructing Concrete Roads

BUILDING OF PAVED ROADS is proceeding faster than ever before, William M. Kinney, general manager of the Portland Cement Association, declares.

Mr. Kinney states that although fewer streets and alleys are being paved as yet, the contracts awarded for concrete rural roads have been great enough to bring the total awards for all concrete pavement to more than 64,666,000 sq. yd. for the first five months of the year. This is a gain of one-eighth over the same period in 1929.

In so far as hard surfacing is concerned, 1930 is likely to set a new world's record in road building, Mr. Kinney asserts. In 1928, when a high record was established, awards for the construction of 64,289,500 sq. yd. of concrete were made during the first five months. This is the equivalent of 6088 miles of 18-ft. pavement. Awards so far this year are the equivalent of 6123 miles.

Employes of the Medusa Toledo plant marching to the site of the dedication ceremonies led by a band

Medusa Plants Dedicate Safety Trophies

Mills at Toledo, Ohio, and York, Penn., First to Win Safety Prize of Association

ANOTHER OF THE LARGER cement companies of the country joined the list of the holders of safety honors in the Portland Cement Association when the Toledo and York (grey cement) plants of the Medusa Portland Cement Co. recently received and unveiled their concrete monuments for perfect safety records during 1929.

The Toledo plant held its ceremonies on Tuesday, June 10, and the York plant on Monday, June 16. The records of both plants are highly gratifying. The last lost-time accident occurred in the Toledo plant on April 5, 1928, over 26 months ago, and in the York plant on November 24, 1928. The decline in accident frequency since the Toledo plant was placed in operation in 1923 is particularly interesting, as it is revealed by the following table:

Year	No. of lost-time accidents
1923	29
1924	22
1925	16
1926	19
1927	2
1928	1
1929	0
1930 (to date)	0

While the detailed records of the York plant are not available for comparison, the latter mill has had a comparative record since beginning operation more than two years ago. In addition, it is believed to have the distinction of being the only cement mill built complete from foundation to stacks without a lost-time accident.

Celebration at Toledo

The Toledo dedication ceremonies were held at 2 o'clock on the afternoon of June 10. Present for the occasion were many of the principal officers of the Medusa and its subsidiary companies, including President J. B. John and Vice-President H. Vanderwerp (of the Manitowoc company) and others. The entire executive staff of the operating department was present, headed by W. L. White, Jr., general superintendent; W. E. Wuerth, superintendent of the Dixon, Ill., plant; F. E. Town, superintendent of the Manitowoc plant; A. J. Little, superintendent of the Bay Bridge plant; W. P. Rice, superintendent of the Wampum plant, and L. E. Smith, superintendent of the Newaygo plant.

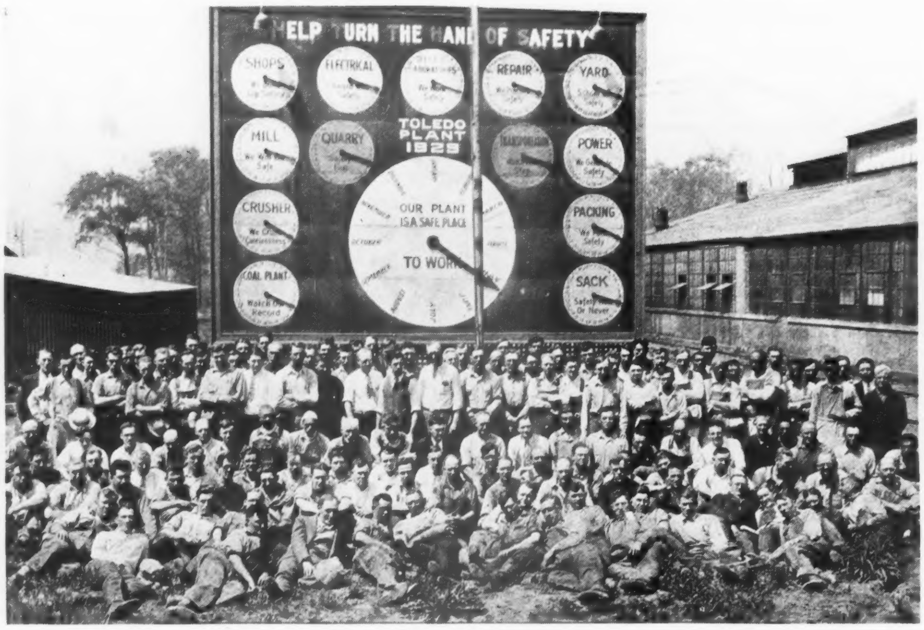
Mary Jane Worthy, daughter of the superintendent of the Toledo Medusa plant and grand-daughter of President John, unveils the safety trophy

Led by a band, the entire force of the Toledo plant marched to the site of the trophy near the plant entrance and joined the large crowd of visitors and guests. General Superintendent W. L. White, Jr., called upon Rev. J. E. Braun of Venice, Ohio, to invoke the divine blessing. After extending a hearty welcome, Mr. White introduced A. J. R. Curtis of the Portland Cement Association, who presented the trophy on behalf of the association's board of directors and members.

The trophy was then unveiled by Mary Jane Worthy, daughter of Superintendent W. J. Worthy of the plant and granddaughter of President J. B. John. Mr. Worthy accepted it for the plant and a short address of appreciation to the employes of the organization was made by Mr. John.

Hon. W. H. Jackson, mayor of Toledo, spoke in highest praise of both the management and men, marveling at the ability shown in handling so large and hazardous

The safety committee of the York, Penn., Medusa plant. Standing, left to right, Messrs. Stewart, Casseday, Shane, Leonard, W. Ashton, Aldinger, R. Ashton and Rowe. Seated are Messrs. Koch, Stehman, Whitlatch, William Heidler, McMichael, Werner, Kohr and John Heidler



Toledo Medusa plant men who helped "put over" a perfect safety record

an industry without an accident for over two years. C. F. Casey of Cleveland, former head of the Ohio Compensation Commission and now connected with the safety work of the state, emphasized that safety was much more profitable than compensation and complimented the plant organization on its record. It became known during the meeting that so far in 1930 no one of the nine Medusa plants has suffered a lost-time accident, producing a unique record which it is hoped will culminate in the award of nine trophies at the completion of the year.

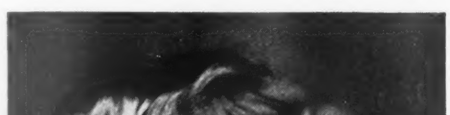
York Shows Safety Spirit

Ceremonies incident to the dedication and unveiling of the second Medusa trophy at the York, Penn., grey cement plant were equally as spirited as those at Toledo. The York celebration took place on Monday afternoon, June 16. It became evident from the statement of General Superintendent W. L. White, Jr., who presided, that York plant was then completing its 585th day without accident and that everyone felt that the mill force could and would complete the year without accident.

Rev. Dr. J. B. Baker of York opened the ceremonies with an invocation. A. J. R. Curtis of the Portland Cement Association presented the trophy. It was unveiled by Miss Ursula Kohr, daughter of the chief electrician of the York plant. Superintendent R. J. Landis accepted the trophy on behalf of his men and in thanking the Portland Cement Association for the trophy and for the association's interest and help, served notice that the York white cement plant, of which he is also superintendent, would be in line to receive its trophy at the end of 1930.

President J. B. John arose, amid cheering, to express his gratitude to the men for their faithful co-operation in the company's safety work. Mr. John said that no achievement within his company organization would mean as much to him or give the company as much prestige as would a perfect safety record at all Medusa mills during 1930. Vice-President E. J. Maguire congratulated the men heartily and expressed the confident belief that they could avoid accident during 1930 in all Medusa mills, thereby hanging up a new record for the "safest" industry.

Col. H. A. Reninger of the Lehigh Portland Cement Co. gave an enthusiastic talk on public safety. During his address two Pennsylvania railroad locomotives competed with the colonel for attention by whistling incessantly and the speaker explained that the engines came up to lend emphasis. Near the conclusion of his address some 20 shots went off in a quarry blasting operation nearby, convincing the crowd that the colonel was using these local industrial noises to drive home his remarks.



W. J. Worthy, superintendent of the Medusa Toledo plant

Thomas J. Quigley, chief of the quarry and cement section of the Pennsylvania Department of Labor and Industry, as the speaker of the day, paid the highest compliments to the safety work at York plant and in the cement industry as a whole. Mr. Quigley stated that he had found that the cement industry, under the leadership of the Portland Cement Association, had run away from all of the others in accident prevention progress and he predicted that the results would go even farther, as long as the same spirit and effort continued.

Music was furnished between speeches by a fine local orchestra and the ceremonies were closed with the singing of "America" by the assemblage, accompanied by the orchestra. Light refreshments were served from a nearby stand and inspection parties were arranged as desired to take the guests through the mill.

Safety Record Celebrated in Community Party at Mildred

IN honor and in appreciation of a record of over two calendar years without a lost-time or other serious accident in its mill at Mildred, Kan., the Consolidated Cement Corp. held "open house" on Sunday afternoon, June 8. The surrounding communities were invited to gather with the Mildred employes and their families for a program which included the rededication of the safety trophy awarded to the plant a year ago for a clear record in 1928, a reception to visiting officials, a first-aid demonstration and a session with the picnic lunch.

Among the visiting officials present were John L. Senior, president of the Consolidated Cement Corp.; F. E. Dodge, chief engineer, James E. Curtis, general superintendent, J. H. Greene, general purchasing agent, all of Chicago; L. W. Rogers, sales director, Kansas City; H. F. G. Wulf, president, Monarch Cement Co., Humboldt, Kan.; J. A. Lehaney, vice-president, Lone Star Cement Co., Kansas; C. A. Swiggett, superintendent, Lehigh Portland Cement Co., Iola, Kan.; C. P. Mitchell, superintendent, Monarch Cement Co.; William Palmer, superintendent, Consolidated Cement Corp., Fredonia, Kan.; J. H. Burgess, assistant superintendent, Missouri Portland Cement Co., Sugar Creek, Mo.; Baxter McClain, Kansas City manager of the Cement Institute, and A. J. R. Curtis of the Portland Cement Association.

The formal program in connection with

the rededication of the trophy was as follows:

Music by Moran band, Moran, Kan.

Introductory remarks—R. M. Johnson, district superintendent.

Invocation—Rev. E. M. Judd.

Rededication of the safety trophy—A. J. R. Curtis.

Response—E. L. Drury, assistant superintendent.

The president's remarks—John L. Senior.

"Working for Safety"—F. C. Lynch, director, Kansas City Safety Council.

Telegrams and messages from friends read by L. W. Rogers, sales director.

Song, "America," by the assemblage.

Demonstration by plant first-aid team.

Raising of June no-accident flag.

Following the program the refreshment stands on the plant grounds were opened up and picnic lunch, soft drinks and ice cream cones were dispensed by the safety committee to a crowd of more than a thousand persons. On the previous evening, General Superintendent J. E. Curtis was host at a dinner to a group of company officials and guests at Iola, near Mildred, and on Sunday noon, June 8, company officials and special guests were given a dinner party in Mildred.

The 1929 safety committee at the Mildred plant of the Consolidated Cement Corp. Top row, left to right, Carl Troxel, L. H. Farmer, R. M. Johnson, Floyd Walton, R. L. Patterson, W. W. Hughes, L. L. Brock, E. L. Drury and C. Sutton. Lower row, Bert Hooker, J. J. Adams, J. E. Ketchum, W. W. Allen and H. E. Rich

Cement Mill Accidents During the Month of May

CEMENT PLANT ACCIDENTS during May, 1930, were less numerous than during the corresponding month of any year of record. The 56 accidents which appear against the record of the month include 50 causing loss of time, four resulting in permanent partial disabilities and two fatalities. During May, 1929 there were three fatal mishaps.

Both of the accidents during May, 1930, which caused loss of life, occurred in quarries. In the first instance a well driller who had moved his drills to a new location failed to ground it, with the result that he was electrocuted by making contact with the live side of the drill circuit.

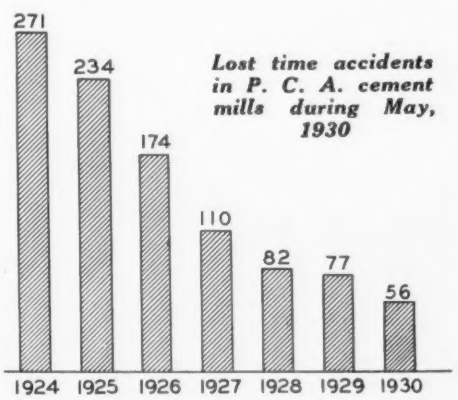
In the second fatal accident of the month a laborer who was helping to remove a broken brake band allowed it to fall on live collector rings the insulated cover over which had been removed to facilitate work. Contact caused immediate death.

No Accidents Since January 1, 1930

The Portland Cement Association reports that 76 of its member mills have reported no lost-time or fatal accidents during the first five months of 1930 as against 73 mills which made a similar record during the first five months of 1929. Cement mills which constitute the 1930 "Trophy Club," the potential winners of the award, are as follows:

Alpha Portland Cement Co. plants at Birmingham, Ala., Cementon, N. Y., Ironton, Ohio, LaSalle, Ill., Manheim, W. Va., Martin's Creek, Penn., No. 3, and St. Louis, Mo.; Ash Grove Lime and Portland Cement Co., Chanute, Kan.

Canada Cement Co., Ltd., plants at Exshaw, Alta., Fort Whyte, Man., Hull, Que.,



and Port Colbourne, Ont.; Consolidated Cement Corp. at Fredonia and Mildred, Kan.; Cowell Portland Cement Co., Cowell, Calif.

Diamond Portland Cement Co., Middlebranch, Ohio.

Federal Portland Cement Co., Buffalo, N. Y.; Florida Portland Cement Co., Tampa, Fla.

Giant Portland Cement Co., Egypt, Penn. (Central and Reliance plants); Great Lakes Portland Cement Corp., Buffalo, N. Y.

International Portland Cement Co., Spokane, Wash.

Lehigh Portland Cement Co. plants at Bath, Penn., Birmingham, Ala., Fogelsville, Penn., Iola, Kan., Mason City, Iowa, Mitchell, Ind., New Castle, Penn., Ormrod, Penn., No. 2 and No. 3, and Sandts Eddy, Penn.

Lone Star Cement Co., Indiana, Greencastle, Ind.; Lone Star Cement Co., Louisiana, New Orleans, La.; Lone Star Cement Co., Texas, Houston, Tex.; Louisville Cement Co. Speed, Ind.

Manitowoc Portland Cement Co., Manitowoc, Wis.; Medusa Portland Cement Co. plants at Bay Bridge, Ohio, Dixon, Ill., Toledo, Ohio, Wampum, Penn., York, Penn., grey plant, York, Penn., white plant.

Nazareth Cement Co., Nazareth, Penn.; Newaygo Portland Cement Co., Newaygo, Mich.; North American Cement Corp., Hagerstown, Md., and Howes Cave, N. Y.; Northwestern Portland Cement Co., Grotto, Wash.

Pacific Portland Cement Co., San Juan Bautista, Calif.; Peerless Portland Cement Co., Port Huron, Mich.; Pennsylvania-Dixie Cement Corp. plants at Nazareth, Penn., No. 4, and Nazareth, Penn., No. 5, and Portland Point, N. Y.; Petoskey Portland Cement Co., Petoskey, Mich.; Portland Cement Co. of Utah, Salt Lake City, Utah.

Riverside Portland Cement Co., Oro Grande, Calif.

San Antonio Portland Cement Co., San Antonio, Tex.; Southwestern Portland Cement Co. plants at Victorville, Calif., and Osborn, Ohio.

Three Forks Portland Cement Co., Hanover, Mont., and Trident, Mont.; Trinity Portland Cement Co., Fort Worth and Houston, Tex.

Universal Atlas Cement Co. plants at Buffington, Ind., No. 3, Duluth, Minn., Hudson, N. Y., Independence, Kan., Northampton, Penn., Nos. 2, 3 and 4, and Pittsburgh, Penn.

Vulcanite Portland Cement Co., Vulcanite, N. J., No. 2.

Wabash Portland Cement Co., Stroh, Ind.; Wellston Iron Furnace Co., Superior, Ohio; West Penn Cement Co., Butler, Penn.; Wolverine Portland Cement Co., Quincy, Mich.

While it is known that a few mills on the above list will not operate the minimum of six months required for eligibility for the association trophy, these names will be eliminated at such time as their opportunity to complete over six months of operation shall expire. For example, any mill on the list which has not operated since January 1 is automatically removed from the list on July 1.

Misfires; Causes and Prevention

AT one of the regular meetings of the American Institute of Mining and Metallurgical Engineers held at New York City, three papers dealing with misfires were presented. These papers, "Misfires in Anthracite Coal Mines," by T. D. Thomas; "Misfires in Bituminous Mines," by W. H. Forbes, and "Misfires in Non-Metallic Mining (Limestone)," by A. W. Worthington, are embodied in Technical Publication No. 257 of the Institute of Mining and Metallurgical Engineers.

The paper by Mr. Worthington is of special interest to quarry operators as the author is assistant to the general manager of the Pittsburgh Limestone Co. and quite competent to talk on the subject. His paper outlines, as the title indicates, causes of misfires but also includes a discussion of how to treat them, and gives other statistical data of value to the industry.

Regional Safety Meeting at Easton Breaks Record

THE RECENT REGIONAL Safety Meeting and banquet held in the Hotel Easton, Easton, Penn., drew the largest attendance of any similar gatherings in that section. A picture of the banquet was shown in our last issue. The registration indicated the following in attendance:

Alpha Portland Cement Co., Bellevue,, Mich., Gilford Leeser and Albert Toutant, quarry foreman; Alpha, Easton, Penn., plant, Henry B. Anderson, comb. engineer, Matt P. Flynn, paymaster, W. W. Hamilton, J. F. Magee, management engineer, Hugh Merrick, foreman, W. H. Smith, central safety committee, J. L. White and James E. Wesley; Alpha, Ironton, Ohio, plant, W. L. Patterson, mine superintendent; Alpha, Martins Creek, Penn., plant, Jacob Brimn, master mechanic, M. A. Evert, foreman, Clarence R. Hopkins, dynamite expert, Arthur Kindt, foreman, and Raymond Seas, Sr., chief engineer.

Giant Portland Cement Co., Egypt, Penn., C. W. Acker, clerk, William Brandt, foreman, Albert Hack, foreman, A. H. Leh, general foreman, Stanley W. Lutz, assistant general foreman, S. G. McAnally, chief chemist, Thomas G. Miller, foreman, Vincent R. Motring, foreman stripping, Sam Neyouir and H. S. Reppeil, chief electrician.

Hercules Cement Corp., Nazareth, Penn., J. Stanley Downs, superintendent, and Marvin Parsons, labor foreman; Hercules, Stockertown, Penn., plant, Bruce L. Doyle, electrical engineer, Ernest M. Ayres, chief operating engineer, Steward P. Hahn, sack house foreman, Paul H. Houck, storekeeper, and Edgar Rader, master mechanic.

International Cement Corp., New York, N. Y., Wm. Moeller, general superintendent, eastern division.

Lawrence Portland Cement Co., Northampton, Penn., M. S. Ackerman, superintendent, D. Adam, safety engineer, Fred J. Andrews, electrical foreman, Irvin Beck, foreman, Frank D. Daimer, general foreman, Eugene G. Fluck, electrical engineer, Herbert W. Gillespie, assistant foreman, H. F. Hanker, foreman, Oscar Kresge, foreman, Ralph Rothiock, foreman, R. D. Schaffer, master mechanic, J. Edward Shirst, traffic manager, James Watson, foreman, and George E. Young, foreman; Lawrence, Siegfried, Penn., plant, Amos H. Peters, pack house foreman, and M. D. Ryan, yard foreman.

Lehigh Portland Cement Co., Allentown, Penn., C. P. Benner, district safety inspector, H. G. Bonney, C. S. Gaumer, Olin A. Greumer, John Hovel, Alvin Hunt, Fred Lobach, Charles J. Phifer, chemist, and Henry A. Reninger, special representative; Lehigh, Bath, Penn., plant, B. W. Ervin, foreman, Reuben A. Fogel, chief electrician, Elmo J. Frey, mill foreman, Horace H. Heller, Jr., clerk, H. H. Heller, Sr., superintendent, A. K. McIlhaney, timekeeper, Roy H. Rohr, chemist, and Charles Rose, chief steam engineer; Lehigh, Birmingham, Ala., plant, W. H. Jones, foreman, and C. F. Walters, bag house foreman; Lehigh, Egypt, Penn., plant, Herbert George; Lehigh, Fogelsville, Penn., plant, Lewis E. Everett, foreman, B. H. Foore, foreman, Samuel F. Gehringer, Jr., clerk, F. A. J. Haas, storekeeper, George A. Hiel, foreman, Charles E. Keck, foreman, Elmer Kiehns, foreman, George Knappenberger, foreman, John T. Koch, foreman, John J. Kratzer, electrician, Robert J. Laudenslager, Martin O. Lehi, foreman, Wilmer S. Lehi, master mechanic, Raymond A. Moritz, superintendent, Sherwood S. Shaffer, chief engineer, and William C. Stufflet, foreman; Lehigh, Iola, Kan., plant, Lloyd Carter, mechanical engineer, J. A. Fisher, quarry foreman, and C. A. Swiggett, superintendent; Lehigh, Ormrod, Penn., plant, Perry Acker, foreman, Dennis O'Donnell, electrician, Frederick Agate, foreman, Lester G. Diehl, repairman, Floyd E. Diehl, general foreman, John F. Frickert, electrician, George C. Fullajar, chief storekeeper, Willard H. Guth, electrician, S. P. Helfuch, assistant to general foreman, Herman Herb, machinist foreman, F. E. Laubach, carpenter foreman, Samuel W. Laule, chemist, George Leibensperger, foreman, Russell H. Marsh, secretary, Sylvanus Miller, foreman, William J. Montz, superintendent, Charles Robert, foreman, B. F. Roth, foreman, David Scheirer, foreman, Norman H. Sell, chemist, William T. Serbster, foreman, Lawrence Simmons, Granville C. Snyder, quarry foreman, Anson D. Sittler, foreman, and Herman Wetherhold, clerk; Lehigh, Sandts Eddy, Penn., plant, H. M. Dickinshiel, chemist, Robert L. Fow, Milton George, foreman, George Kaufman, Jr., assistant chief engineer, and Karl E. Mauear.

Lone Star Cement Co., Pennsylvania, Nazareth, Penn., E. C. Champion, superintendent, Harry E. Gower, chief clerk, Arleyne E. Heims, secretary, J. H. Heintzelman, chief chemist, Frank B. Leh, master mechanic, Forrest J. Noll, foreman, Edward M. Nunir, quarry superintendent, E. P. Schuerr, general mill foreman, A. D. Schleicher, chief electrician, F. E. Searfass, kiln foreman, and Charles Shaadt, shift foreman.

Nazareth Cement Co., Nazareth, Penn., Elwood Colver, R. G. Cowell, cost accountant, J. C. Evans, research engineer, Robert Frantz, foreman, Charles H. Fehr, machinist, Edward F. Fehr, mill foreman, W. Follweiler, operating superintendent, A. George, kiln foreman, George A. Hagenbuch, foreman, Clyde Hilliard, bag house foreman, F. B. Hunt, electrical engineer, John R. Jones, draftsman, Melvin M. Jones, clerk, W. F. Kern, chief chemist, Charles F. Kiatz, assistant machinist, Frank Marchs, electrician foreman, H. A. Reichenbach, general superintendent, Lawrence R. Rice, safety engineer, Albert A. Schiery, assistant chemist, M. R. Searles, assistant efficiency engineer, G. B. Searles, efficiency engineer, and Harold W. Starner, assistant chemist.

Pacific Portland Cement Co., Redwood City, Calif., P. Forsyth, mill foreman, and H. Stephens, master mechanic.

Pennsylvania-Dixie Cement Corp., Bath, Penn., John Bauer, Jr., laborer, Otolfo Claroni, foreman, Elmer Deck, millwright, W. E. Fry, foreman, Charles Gogel, repairman, Victor A. Gruber, foreman, John Hanszon, boiler house foreman, Wm. F. Hauser, superintendent, Floyd Kimmuiour, foreman, Charles Knecht, foreman, Otto Kobbe, foreman, Fred Manning, foreman, William A. Montz, bag house foreman, Emery Nagy, millwright, William Oltemose, foreman, Spencer M. Reph, chemist, John Rissmiller, machinist, and Lewis Wagner, packing; Pennsylvania-Dixie, Nazareth, Penn., Frank Applegate, labor foreman, Morris Fortuin, general manager, R. B. Fortuin, assistant to general manager, Frank Geremer, mason, C. McGomgles, machinist, Willis F. Hagenbuch, storekeeper, Charles F. Happel, F. Hover, foreman, Wm. C. Kerchner, foreman, William Kilpatrick, repairman, Francis R. Knecht, chief clerk, Richard S. Laubach, chemist, John T. Lazcak, labor foreman, C. D. Newhard, superintendent, Earl E. Rinker, blacksmith, Charles F. Roth, general safety inspector, Wilson D. Roth, general superintendent, Walter J. Roth, bag house foreman, Samuel A. Ruth, skilled laborer, Louis Sakashitz, mill foreman, H. E. Stewart, foreman, Floyd J. Walters, superintendent, Charles Yandaitz, foreman, and John Zerfoss, engineer.

Vulcanite Portland Cement Co., Phillipsburg, N. J., Floyd Brinker, painter, James Pursell, yard foreman, Raymond Renkert, machinist, Daniel Rossetti, pipe fitter, William Rose, pipe fitter foreman, Jason Todd, foreman, S. R. Pursell, civil engineer, Walter B. Simpson, carpenter, S. H. Harrison and John E. Parry.

Universal Atlas Cement Co., Northampton, Penn., A. S. Bennett, assistant carpenter foreman, William Brinkman, foreman, Wm. F. Engler, millwright foreman, Clay W. Harvey, foreman, John Mainshak, conductor, Wm. I. Powers, blacksmithing department, R. Jacob Snyder, foreman, Ralph E. Stern, welder.

Miscellaneous—A. J. R. Curtis, assistant to general manager, Portland Cement Association; C. P. Derr, John W. Kutz, W. S. Lippicott, E. D. Perry, Herbert Schlough, H. Reed Snyder, F. O. Stoneback, Charles Strauss and Roy I. Walter, American Legion; Theodore J. Grayson, professor of finance, University of Pennsylvania, Philadelphia, Penn.; O. P. Hatton, eastern manager Concrete Publishing Co., 295 Madison Ave., New York City; C. W. Jiffers, Bureau of Mines, Pittsburgh, Penn..

Edward S. Martin, Easton High School, Easton, Penn.; Elmer Joseph Miller, teacher, Easton High School, Easton, Penn.; Mrs. William Moeller, New York; Armand Rupelli, Easton High School; Colonel E. C. Spring, Lehigh Valley Transit Co., Allentown, Penn.; Norman M. Stineman, editor, *Concrete*, 400 W. Madison St., Chicago, Ill.

Sherwood F. Watts, district manager, Pennsylvania Manufacturers Association Casualty Insurance Co., 208 E. P. Wilbur Trust Co., Bethlehem, Penn.; George T. Woodring.

The Carbon Limestone Co. Organizes for Safety

STARTING JULY 1, the Carbon Limestone Co. at Hillsville, Penn., began a drive for a "no lost time" month in order to instill in the minds of its 400 employes the necessity of thinking in terms of safety. The company holds the distinction of having one of the safest mechanically guarded quarries and crushing plants in the State of Pennsylvania and is organizing the men so that at some future date the company can say that their workmen also are the safest in the state. The company selected the month of July for this drive as it is the busiest month.

The offices of the Carbon Limestone Co. are in the Central Savings Tower Building, Youngstown, Ohio.

BOOST FOR SAFETY!

We have selected the month of JULY as a

No Lost Time Accident Month

and ask the co-operation of every employee to help us win

For Further Information Watch The Bulletin Board

CARBON LIMESTONE COMPANY

SAFETY COMMITTEE

Typical safety poster used by Carbon Limestone Co.

No Changes in Material Service Preliminary Screening

OUR JUNE 21 ISSUE contained an article describing the Material Service Corporation plant at Lockport, Ill., which might have conveyed an impression that there were changes in the preliminary screening plant. The original preliminary screening plant was equipped with "Gyrex" vibrating screens of the Robins Conveying Belt Co., and these screens are still in use and giving satisfactory service. The changes in screening practice were confined to the finer sizes in the finishing screening plant.

The article does not state there were changes in the crushing plant, but the insertion of the cut of a Gyrex screen on page 49, captioned "One of the vibrating screens in the preliminary screening and crushing plant" might give the impression that it was part of the changes described in the article.

Cement Association Publishes Concrete Pavement Booklet

THE PORTLAND CEMENT ASSOCIATION has recently issued a 28-page illustrated booklet entitled "Pavements for Modern Traffic." Street problems which concern city officials, business men and property owners are covered in the booklet, and such important topics as concrete paving practice on steep grades, between car tracks, on heavy traffic streets and elsewhere are discussed in a helpful way. Copies will be sent free on request to the association at 33 West Grand avenue, Chicago, Ill.

The National Safety Competition for 1929

SUPERVISING STATISICIAN W. W. ADAMS of the United States Bureau of Mines, Department of Commerce, has summarized the safety records at quarries and mines for the calendar year 1929. The statistics were reprinted from the United States Bureau of Mines Report of Investigations No. 3019.

To the winners of each of the five groups into which the contestants were divided, the bronze "Sentinels of Safety," donated by the *Explosives Engineer* magazine, was awarded.

Records of the national safety competition of 1929 confirm those of previous years which showed that most mining and quarrying companies have better safety records than are indicated by the average figures for all mines as a group. The group, which included quarries and open-cut mines, reduced its accident-frequency rate, but suffered an increase in its severity rate on account of an increase in fatalities and permanent partial disabilities, an increase which more than counterbalanced a reduction in the rate for temporary injuries.

The accident-frequency rates indicate the number of fatal, permanent and temporary lost-time injuries for each million man-hours of exposure to hazard. The accident-severity rates indicate the number of days of disability caused by all fatal, permanent and temporary lost-time injuries per thousand man-hours of exposure to hazard. A special charge is made against fatalities and permanent injuries. The severity rate is the basis on which the trophy was awarded in accordance with the rules governing the contest.

The trophy for the best record in quarry or open-cut mines, regardless of the kind of mineral produced, was won by the Michigan Limestone and Chemical Co.'s limestone quarry at Rogers City, Mich., which worked 753,156 man-hours during 1929 without a lost-time accident. All mines and quarries within the group worked 19,752,418 man-hours and had an accident-severity rate of 6.547 and an accident-frequency rate of 26.782.

The trophy for the best safety record at anthracite mines was won by Highland No. 6 mine, at Jeddo, Penn., operated by the Jeddo-Highland Coal Co. This mine worked 142,128 man-hours during the year; it had eight accidents which involved a total of 64 days of disability. The accident-severity rate was 0.450 per million hours, as compared with an average of 10.565 for the entire anthracite group. The accident-frequency rate for Highland No. 6 mine was 56.287 per thousand man-hours, as against an average rate of 101.355 for the group as a whole. In the bituminous group the trophy was awarded to the Hull No. 33 mine at Dora, Ala., which was operated by the DeBardeleben Coal Corp. The mine worked 264,656 man-hours and had three employes injured who lost 21 days as a result of their injuries, hence the mine's accident-severity rate was 0.079 and its frequency rate was 11.336 as compared with 11.571 and 68.937, respectively, for the entire group of bituminous coal mines.

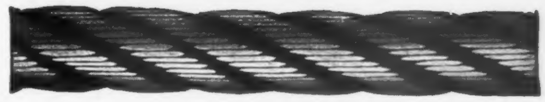
The trophy for metal mines was won by the Berkshire iron-ore mine at Stambaugh, Mich., operated by the Brule Mining Co. The Berkshire mine worked 345,695 man-hours without a lost-time accident during the year. Its accident rate was therefore zero. The combined accident-severity rate for all metal mines competing for the trophy was 5.990 and the combined frequency rate was 52.162 representing an exposure of 18,116,618 man-hours.

The trophy for nonmetallic mineral mines was awarded to the Retsof rock-salt mine of the Retsof Mining Co. at Retsof, N. Y. This mine worked 257,927 man-hours and had no lost-time accidents. This excellent record compares with the group's accident-severity rate of 7.794 and accident-frequency rate of 31.049 and a total of 3,897,004 man-hours of exposure. Both of these rates indicate an improvement over the combined rates for all plants in the previous year's contest.

The reprint concludes with tabulated data showing the relative standing, according to their accident-severity rates, of the quarries and mines that participated in the 1929 National Safety Competition.

Discusses Methods of Raising Rope Safety Factor

IN A RECENT issue of *Mining and Metallurgy*, H. S. Cooley of the American Cable Co. gives some interesting data on what he calls the "factor of economy" in wire ropes. He states that ropes with minimum life had a safety factor of 2.1. Those of maximum life had a factor of safety of 10.7. Assuming cost per foot to be proportional to factor of safety, we have the remarkable coincidence that the rope which makes 5.09 times as many trips costs 5.09 times as much. On the basis of these maximum figures alone, and considering only first cost of rope, it might seem entirely immaterial whether a high or a low factor of safety be adopted.



Partially Worn Regular Lay
Note concentration of wear on individual wires

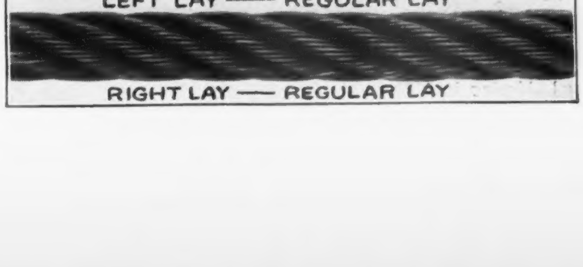
Mr. Cooley points out the savings that may be effected by the use of Lang-lay ropes for hoisting instead of the regular lay. He states that Lang-lay rope has been used extensively and in every case it has been found that Lang-lay ropes outlast those of regular lay.

Partially Worn Lang Lay
Showing distribution of wear

Mr. Cooley states that in Lang-lay both the wires in the strand and the strands in the rope are laid in the same direction, in contrast to ordinary lay in which the strands are left-lay and the rope right-lay, or vice versa.

The effect of this, well illustrated in the accompanying photographs of the two lays, when worn, is to distribute the surface wear over a much greater length of each wire in the Lang-lay than in the regular lay. Not only does this multiply the amount of wear the rope will bear before the wires are reduced to a given cross-section, but for two reasons the cross-section may be reduced further than in regular lay before breakage of wires begins. One is that the variation in cross-section is more gradual, so that strain is less sharply localized and fatigue less rapid. The other is that the worn places come where the wire approaches closest to the shape of a coil spring, and hence is best able to accommodate the strains arising from flexing of the rope.

Because both strands and rope have the same direction of lay, Lang-lay rope has considerably more of a tendency to spin with variation in loading than is true of regular lay rope. This is a real objection in the case of ropes supporting buckets or pulleys free to rotate, but it is of no consequence where the load consists of a cage running on guides, or is otherwise guided so that small torsional stress in the rope will not cause spinning. Hence this property is no objection for mine hoists, slope car haulage or slackline cableway installations and most uses to which wire rope is put to in the rock products industries.



Output of Portland Cement in 1929

Statistics Confirm Estimates Made in January

STATISTICS relating to the portland cement industry in 1929 compiled by the United States Bureau of Mines, Department of Commerce, from the final returns of the producers for the year confirm the estimates published by the Bureau of Mines early in January.

Production of portland cement in 1929—170,646,036 bbl.—showed a decrease of 3% from 1928, the highest year of production. Shipments of portland cement from mills in 1929 amounted to 169,868,322 bbl., valued at $252,153,789, a decrease of 3% in quantity and of nearly 9% in gross value. The average factory price per barrel in bulk in 1929 was $1.48, a decrease of 9 cents per barrel as compared with 1928. Stocks at the mills increased, reaching a total of 23,537,817 bbl. on December 31, 1929, the greatest at the end of any year during which official records of stocks have been kept. They were 3% higher than at the end of 1928.

From the reports of the producers showing mill shipments of portland cement into the various states estimates of per capita consumption in the accompanying table have been compiled. These are at best but approximations, as they represent only the records of mill shipments into states; they do not include the imports, which would increase the consumption in certain states near the Canadian border and the seaboard, nor do they make allowance for a variable but considerable stock of cement at all times in transit, in warehouses at distributing points and awaiting use at jobs.

The commercial capacity for production of finished portland cement of the 163 plants active at the end of 1929, and of three plants idle in 1929 but producing within the two previous years, according to manufacturers' reports supplemented by a few estimates, was 259,344,000 bbl. This total includes, besides increased capacity due to extensions and improvements at old plants, approximately 7,900,000 bbl. capacity for finished portland cement of nine new plants that be-

PORTLAND CEMENT MANUFACTURING CAPACITY OF THE UNITED STATES, BY COMMERCIAL DISTRICTS, 1928 AND 1929

District	Estimated capacity (barrels) 1928	1929	Percentage of capacity utilized 1928	1929
Eastern Pennsylvania, New Jersey and Maryland	50,945,000	53,983,000	77.9	69.9
New York and Maine	17,037,000	18,449,000	67.4	61.9
Ohio, Western Pennsylvania and West Virginia	24,671,000	26,400,000	74.3	67.9
Michigan	19,508,000	18,535,000	71.0	74.2
Wisconsin, Illinois, Indiana and Kentucky	27,057,000	29,293,000	84.1	73.0
Virginia, Tennessee, Alabama, Georgia, Florida and Louisiana	24,667,000	25,034,000	64.7	55.1
Eastern Missouri, Iowa, Minnesota and South Dakota	22,993,000	22,661,000	72.6	69.3
Western Missouri, Nebraska, Kansas, Oklahoma and Arkansas*	14,598,000	17,563,000	74.9	70.6
Texas	7,700,000	9,950,000	82.4	74.1
Colorado, Montana, Utah, Wyoming* and Idaho*	5,567,000	6,669,000	49.8	40.4
California	22,700,000	23,350,000	59.7	56.1
Oregon and Washington	6,259,000	7,457,000	63.3	45.5
	243,702,000	259,344,000	72.3	65.8

*Arkansas, Wyoming and Idaho began producing in 1929.

PORTLAND CEMENT PRODUCED, SHIPPED AND IN STOCK IN THE UNITED STATES, 1928 AND 1929, BY STATES

State	Production: Active plants 1928	Active plants 1929	Barrels 1928	Barrels 1929	Increase or decrease 1929 (per cent)	Shipments: 1928 Barrels	1928 Value	1929 Barrels	1929 Value	Average factory value per barrel 1928	1929	Increase or decrease in quantity 1929 (per cent)	Stock (Dec. 31): Barrels 1928 (revised)	Barrels 1929	Increase or decrease 1929 (per cent)
Alabama	6	6	6,749,202	5,005,967	—26	6,696,684	$8,233,872	5,228,947	$5,911,031	$1.23	$1.13	—22	743,869	520,889	—30
California	12	12	13,555,579	13,091,899	— 3	13,699,851	25,906,942	12,964,746	22,805,576	1.89	1.76	— 5	819,914	947,067	+16
Illinois	• 4	4	7,334,833	8,242,725	+12	7,405,667	11,602,848	7,738,208	11,134,538	1.57	1.44	+ 4	697,441	1,201,958	+72
Iowa	6	6	7,070,172	6,373,330	—10	6,880,731	10,734,838	6,586,111	9,781,150	1.56	1.49	— 4	1,559,926	1,347,144	—14
Kansas	7	7	6,574,219	6,739,741	+ 3	6,787,568	10,091,330	6,855,861	10,041,282	1.49	1.46	+ 1	911,812	795,692	—13
Michigan	14	14	13,848,561	13,748,862	—0.7	14,044,230	19,268,707	13,325,727	18,916,711	1.37	1.42	— 5	2,010,520	2,433,655	+21
Missouri	5	5	7,881,118	8,113,304	+ 3	7,943,367	12,367,018	7,984,337	11,557,905	1.56	1.45	+ 5	896,878	1,025,845	+14
New York	11	10	10,960,204	10,761,368	— 2	10,983,950	16,748,773	10,742,992	15,597,868	1.52	1.45	— 2	1,504,972	1,523,348	+ 1
Ohio	10	10	9,233,033	9,427,084	+ 2	9,364,338	14,928,183	9,144,085	13,427,778	1.59	1.47	— 2	1,074,074	1,357,073	+26
Pennsylvania	26	27	41,522,401	39,354,470	— 5	41,161,019	62,572,588	39,309,662	55,600,953	1.52	1.41	— 4	5,907,235	5,952,043	+0.8
Tennessee	6	6	4,689,703	4,442,249	— 5	4,634,280	6,322,213	4,537,601	5,576,235	1.36	1.23	— 2	571,018	475,666	—17
Texas	7	9	6,345,604	7,374,428	+16	6,231,083	10,938,646	7,083,572	11,805,779	1.76	1.67	+14	521,924	812,780	+56
Other states*	42	47	40,534,217	37,970,609	— 6	40,005,564	66.256,987	38,366,473	59,996,974	1.66	1.56	— 4	5,540,521	5,144,657	— 7
	156	163	176,298,846	170,646,036	— 3	175,838,332	$275,972,945	169,868,322	$252,153,789	$1.57	$1.48	— 3	22,760,103	23,537,817	+ 3

*Includes Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin and Wyoming.

PORTLAND CEMENT PRODUCED, SHIPPED AND IN STOCK IN THE UNITED STATES, 1928 AND 1929, BY DISTRICTS

District	Production: Active plants 1928	Active plants 1929	Barrels 1928	Barrels 1929	Increase or decrease 1929 (per cent)	Shipments: 1928 Barrels	1928 Value	1929 Barrels	1929 Value	Average factory value per barrel 1928	1929	Increase or decrease in quantity 1929 (per cent)	Stock (Dec. 31): Barrels 1928 (revised)	Barrels 1929	Increase or decrease 1929 (per cent)
Eastern Penn., N. J. and Maryland	25	25	39,677,010	37,726,967	— 5	39,738,910	$60,236,388	37,647,014	$53,042,469	$1.52	$1.41	—55	5,113,231	5,193,184	+ 2
New York and Maine	12	11	11,484,054	11,418,596	— 1	11,357,052	17,386,416	11,519,619	16,780,423	1.53	1.46	+ 1	1,655,720	1,554,697	— 6
Ohio, Western Penn. and West Virginia	18	19	18,326,478	17,936,179	— 2	18,037,131	28,375,472	17,737,226	25,922,200	1.57	1.46	— 2	2,835,684	3,034,637	+ 7
Michigan	14	14	13,848,561	13,748,862	—0.7	14,044,230	19,268,707	13,325,727	18,916,711	1.37	1.42	— 5	2,010,520	2,433,655	+21
Wis., Ill., Ind., Ky.	11	11	22,748,604	21,378,418	— 6	22,627,309	35,575,358	21,171,227	31,168,394	1.57	1.47	— 6	2,735,536	2,942,727	+ 8
Va., Tenn., Ala., Ga., Fla. and La.	19	19	15,949,537	13,792,618	—14	15,770,338	21,253,288	14,047,259	17,689,012	1.35	1.26	—11	1,895,931	1,641,290	—13
Eastern Mo., Iowa Minn. and S. D.	12	12	16,692,696	15,697,414	— 6	16,544,026	25,777,858	15,984,176	23,430,891	1.56	1.47	— 3	2,882,044	2,595,282	—10
Western Mo., Nebr. Kan., Okla., Ark.*	11	13	10,938,637	12,392,722	+13	11,221,802	17,444,193	12,267,352	18,124,275	1.55	1.48	+ 9	1,333,940	1,459,310	+ 9
Texas*	7	9	6,345,604	7,374,428	+16	6,231,083	10,938,646	7,083,572	11,805,779	1.76	1.67	+14	521,924	812,780	+56
Colo., Mont., Utah, Wyo.* and Idaho*	7	9	2,771,863	2,695,024	— 3	2,628,003	5,698,753	2,776,167	5,764,757	2.17	2.08	+ 5	527,508	456,365	—13
California	12	12	13,555,579	13,091,899	— 3	13,699,851	25,906,942	12,964,746	22,805,576	1.89	1.76	— 5	819,914	947,067	+16
Oregon and Wash.	8	9	3,960,223	3,392,909	—14	3,938,597	8,110,924	3,354,237	6,703,302	2.06	2.00	—15	428,151	466,823	+ 9
	156	163	176,298,846	170,646,036	— 3	175,838,332	$275,972,945	169,868,322	$252,153,789	$1.57	$1.48	— 3	22,760,103	23,537,817	+ 3

*Arkansas, Wyoming and Idaho began producing and shipping in 1929.

gan operating during the year and are located one each in Arkansas, California, Idaho, Nebraska, Pennsylvania, Washington and Wyoming, and two in Texas. The capacity of two plants reported out of business in 1929 and idle in that year and in 1928 has been excluded from the figures for 1929. The total production for 1929 was 65.8% of the indicated capacity at the close of the year; the corresponding figure for 1928 is 72.3%.

A summary of the monthly estimates of output of portland cement in 1929, compiled from monthly reports of the producers, was published early in January, 1930, by the Bureau of Mines. These estimates, which indicated a production of 170,198,000 bbl. and shipments of about 169,394,000 bbl., were within 0.3% each of the figures for 1929 here presented. The statistics were prepared under the supervision of Frank J. Katz, chief of the Division of Mineral Statistics.

SHIPMENTS OF DOMESTIC PORTLAND CEMENT FROM MILLS INTO STATES AND PER CAPITA, 1928 AND 1929, IN BARRELS*

State	1928 Total	1928 Per capita*	1929 Total	1929 Per capita*
Alabama	2,949,527	1.15	1,958,089	0.76
Arizona†	692,754	1.46	656,775	1.39
Arkansas‡	1,251,341	.64	1,555,517	.80
California	12,453,852	2.73	11,802,278	2.59
Colorado	1,064,945	.98	891,973	.82
Connecticut†	2,283,726	1.37	1,908,868	1.15
Delaware†	348,719	1.43	365,257	1.50
District of Columbia†	889,674	1.61	1,126,946	2.04
Florida	1,325,921	.94	1,176,495	.83
Georgia	1,742,530	.54	1,423,359	.44
Idaho‡	294,925	.54	261,378	.48
Illinois	17,683,269	2.39	13,490,520	1.82
Indiana	5,297,337	1.67	5,674,739	1.79
Iowa	5,348,807	2.20	5,462,534	2.25
Kansas	2,341,459	1.28	2,605,330	1.42
Kentucky	1,740,245	.68	1,575,715	.62
Louisiana	1,276,127	.65	1,657,154	.85
Maine	522,573	.66	600,423	.76
Maryland	2,242,541	1.39	2,426,107	1.50
Massachusetts†	2,916,526	.68	2,908,230	.68
Michigan	11,776,282	2.57	11,686,635	2.55
Minnesota	3,054,583	1.12	3,212,554	1.18
Mississippi†	1,128,613	.63	1,028,561	.57
Missouri	4,718,602	1.34	5,620,624	1.60
Montana	461,299	.84	552,357	1.01
Nebraska	1,195,650	.85	1,470,294	1.04
Nevada†	106,321	1.37	133,132	1.72
New Hamp.†	515,317	1.13	665,519	1.46
New Jersey	8,436,886	2.21	8,015,348	2.10
New Mexico†	333,250	.84	286,473	.72
New York	22,325,087	1.93	21,039,518	1.82
North Carolina†	2,401,733	.82	1,753,324	.60
North Dakota†	454,873	.71	444,798	.69
Ohio	11,017,572	1.61	10,033,158	1.47
Oklahoma	3,125,602	1.29	3,352,328	1.38
Oregon	1,257,195	1.39	1,017,434	1.13
Pennsylvania	12,996,626	1.32	13,135,444	1.33
Rhode Island†	760,813	1.06	721,352	1.01
South Carolina†	1,508,279	.81	1,190,008	.64
South Dakota	491,102	.70	530,455	.75
Tennessee	2,699,338	1.08	2,934,953	1.17
Texas	6,193,925	1.13	7,584,278	1.38
Utah	507,986	.96	521,047	.98
Vermont†	605,930	1.72	928,881	2.64
Virginia	1,995,529	.77	1,764,760	.69
Washington	2,974,407	1.87	2,477,520	1.56
West Virginia	1,360,597	.79	1,415,161	.82
Wisconsin	5,382,421	1.82	5,517,598	1.87
Wyoming‡	198,194	.80	192,995	.78
Unspecified	29,916	......	0	......
	174,680,726	1.46	168,754,196	1.41
Exports reported by manufacturers but not included above§	1,157,606	......	1,114,126	......
Total shipped from cement plants	175,838,332	......	169,868,322	......

*Per capita figures based on latest available estimates of population made by the Bureau of the Census.
†Non-cement-producing state.
‡Arkansas, Idaho and Wyoming began producing and shipping in 1929.
§Includes shipments to Alaska, Hawaii and Porto Rico.

*Imports and Exports**

IMPORTS OF HYDRAULIC CEMENT BY COUNTRIES AND BY DISTRICTS IN 1929

Imported from	District into which imported	Barrels	Value Dollars
Belgium	Connecticut	3,000	3,094
	Florida	15,750	17,188
	Galveston	14,400	21,297
	Hawaii	100	212
	Los Angeles	476,343	266,944
	Massachusetts	272,418	341,002
	New Orleans	35,972	44,342
	New York	73,320	91,363
	North Carolina	38,495	47,879
	Oregon	34,461	41,968
	Philadelphia	55,729	77,905
	Porto Rico	40,001	67,701
	Rhode Island	35,750	45,105
	Sabine	5,500	8,988
	San Antonio	19,432	20,825
	South Carolina	63,245	77,899
	Washington	2,250	2,907
	Total	1,186,166	1,176,619
Canada	Alaska	48	218
	Duluth and Superior	9	23
	Me. & N. H.	5,740	12,997
	Vermont	6	15
	Total	5,803	13,253
Denmark	Los Angeles	100	255
	Maryland	3,489	7,000
	Massachusetts	6,000	6,300
	New York	74,577	80,456
	Porto Rico	235,513	319,794
	Total	319,679	413,805
France	Massachusetts	2,083	3,829
	New York	5,007	10,442
	San Francisco	792	1,990
	Total	7,882	16,261
Germany	Los Angeles	17,675	32,860
	New York	13	36
	San Francisco	498	1,018
	Total	18,186	33,914
Italy	New York	1,180	4,338
Norway	Porto Rico	2,700	3,671
	San Francisco	7,750	8,525
	Total	10,450	12,196
Sweden	New York	88	517
	San Francisco	51	56
	Total	139	573
United K'gd'm.	Los Angeles	500	809
	New Orleans	501	760
	New York	158,793	243,137
	Philadelphia	15,604	19,295
	Virginia	3,017	3,280
	Total	178,415	267,281
	Grand total	1,727,900	1,938,240

*Compiled from records of the Bureau of Foreign and Domestic Commerce and subject to revision.

EXPORTS OF HYDRAULIC CEMENT BY COUNTRIES IN 1928 AND 1929

Exported to:	1928 Barrels	1928 Value	1929 Barrels	1929 Value
Canada	39,927	$ 202,628	60,172	$ 273,079
Cent. Amer.	125,718	370,219	143,059	353,234
Cuba	99,907	256,201	102,257	247,876
Other W. Ind. & Bermuda	57,382	145,759	67,271	173,480
Mexico	77,676	250,371	174,208	531,982
So. Amer.	342,546	1,240,132	274,393	1,120,545
Other coun.	81,500	473,392	63,961	383,023
	824,656	$2,938,702	885,321	$3,083,217

DOMESTIC HYDRAULIC CEMENT SHIPPED TO ALASKA, HAWAII, AND PORTO RICO, IN 1928-1929*

	1928 Barrels	1928 Value	1929 Barrels	1929 Value
Alaska	13,838	$41,430	17,906	$54,052
Hawaii	291,305	681,468	289,040	687,904
Porto Rico	46,700	114,409	45,397	105,325
	351,843	$837,307	352,343	$847,281

*Compiled from records of the Bureau of Foreign and Domestic Commerce and subject to revision.

In addition to the imports shown in the preceding tables there are also reported "imported for consumption white nonstaining portland cement": in 1928, 16,308 bbl., valued at $44,445; in 1929, 25,072 bbl., valued at $54,045.

IMPORTS OF HYDRAULIC CEMENT IN 1928 AND 1929, BY DISTRICTS

District	1928 Barrels	1928 Value	1929 Barrels	1929 Value
Alaska	....	....	48	$218
Connecticut	....	....	3,000	3,094
Duluth-Superior	....	....	9	23
Florida	72,806	$91,548	15,750	17,188
Galveston	105,637	137,691	14,400	21,297
Hawaii	37,444	47,438	100	212
Los Angeles	15,188	28,780	494,618	300,868
Me. & N. H.	50,335	98,862	5,740	12,997
Maryland	4,166	3,555	3,489	7,000
Mass.	470,340	660,914	280,501	351,131
N. Orleans	15,584	20,246	36,473	45,102
New York	222,833	302,259	312,978	430,289
No. Car.	177,260	238,586	38,495	47,879
Ohio	2	12	....	....
Oregon	70,728	87,583	34,461	41,968
Phila.	167,522	237,523	71,333	97,200
Porto R.	324,186	432,954	278,214	391,166
Rhode Isl.	54,036	71,016	35,750	45,105
Sabine	6,420	13,564	5,500	8,988
St. Lawr.	1,510	2,894	....	....
San Anton.	15,000	17,700	19,432	20,825
San Fran.	380	725	9,091	11,589
So. Car.	413,055	516,084	63,245	77,899
Vermont	974	1,378	6	15
Virginia	1,200	1,328	3,017	3,280
Wash.	57,479	78,220	2,250	2,907
	2,284,085	$3,090,860	1,727,900	$1,938,240

The Use of Lime in Industrial and Chemical Processes

THE NATIONAL LIME ASSOCIATION, Washington, D. C., has published an 88-page bulletin giving some very interesting information on the uses of lime in various industries and outlining the processes and the way in which it is used, as well as the kinds of lime best suited to each particular application.

The industries covered include steel, paper, glass, sugar, soda ash and bleaching powder, sand-lime and silica brick, rubber, varnish and pigments, greases, textiles and dyestuffs, leather and water treatment.

Standard specifications for lime as used in a number of industrial processes have been developed in co-operation with the American Society for Testing Materials. Included in these are specifications for the use of lime in the manufacture of paper, sulphite pulp, varnish, textiles, silica brick and water treatment, as well as analysis, sampling, inspection, packing and working of quicklime and lime products.

The bulletin and also the specifications are available through the National Lime Association, Washington, D. C.

Tractor Lubrication Described

THE TEXAS CO., Dept. H, 135 East 42nd St., New York City, has published under date of April, 1930, in its monthly publication, a technical article on the lubrication of tractors. The pamphlet, designated as Volume 16, Number 4, brings out the power economies that are possible by the proper selection and use of lubricants for this type of work.

Pressure in Indiana to Use Home-Made Cement

FAILURE of government agencies to urge patronizing of home industries in the buying of materials for public improvements, by way of combating out-state freight and price boycotts, may peril solvency of several major Indiana manufacturers.

This assertion, with a declaration that one manufacturing concern will be forced into a temporary shutdown, closing its doors to 250 employes on July 1, because of out-state competition, was hurled at Marion county commissioners recently, as a result of the opening of the county's $500,000 road improvement program.

R. U. Van Degrift, salesman for the Lone Star Cement Co., Indiana, Inc., told commissioners that the $4,000,000 Lone Star plant at Limedale, near Greensburg, will halt operations because contractors refuse to patronize Hoosier manufacturers.

Government agencies should require contractors to use Indiana products in public improvements, Mr. Van Degrift asserted to the board.

He produced evidence showing that other states, Illinois and Ohio in the main, make it imperative that bidders for government work use products of their respective states.

He contended that Indiana government boards are lax in failing to require contractors to use products of this state.

Present unsteady business conditions now make warehouse sales of material manufacturers a negligible factor, Mr. Van Degrift declared. He asserted that business obtained through government agencies is the one hope of Hoosier manufacturers to combat out-state industries.

"Marion county's improvement program alone entails 70,000 bbl. of cement," Mr. Van Degrift said, "and offers at this time probably the only revenue in which Hoosier cement manufacturers can hope to share."

He declared that bulk prices set by out-state cement manufacturers are the same as the prices submitted by Indiana dealers, but that local contractors will not buy Indiana cement because of freight rate complications.

"The Lone Star company's bid is in almost every case the same per barrel as the bid of out-state manufacturers. Because we will not knock off the difference in freight charges, contractors will not buy from us," Mr. Van Degrift said. The final price, he stated, is ultimately the same.

Shutdown of the Limedale plant will injure Indiana coal dealers, Mr. Van Degrift asserted, costing them the sale of thousands of tons of coal used in making of cement.

He recommended that municipal agencies make it imperative for contractors to use home products, except in cases where price differences are extreme.

The suggestion is being considered seriously by Marion county, Commissioner John E. Shearer said today.

"What other states are doing to help home industries should be practiced in this state," Mr. Shearer said. —*Indianapolis* (Ind.) *Times.*

Investigation of Louisiana Highway Purchases of Sand and Gravel

MANY GRAVEL COMPANIES doing business with the Louisiana highway commission are paying commissions of 10% to an agency which has the duty of passing the gravel orders obtained on competitive bids, on to the successful bidders, the senate committee on public roads and highways was told recently in the course of its investigation of the affairs of the commission.

George H. Jones, record clerk of the Louisiana sales agency, which has offices in the Louisiana National Bank building near the highway commission office, testified before the committee the companies presented their bids to the commission for gravel and that when the commission wanted the gravel from these companies the orders were handed to his agency and they forwarded the orders to the gravel companies, who paid them 10% for their services.

Mr. Jones said the agency, so far as he knew, was owned by John Barcelone, of Baton Rouge, who is assistant chief of the enforcement division of the department of conservation. Joe Brunot, son of Supreme Justice H. F. Brunot, denied on the witness stand that he had any interest in the agency. —*Shreveport* (La.) *Journal.*

Cargo of Sand Shipped from Baltimore to San Francisco

PACKED TIGHT in the hold of the steamer *Tashmoo* at Locust Point is 2,000 tons of sand, one of the most unusual cargoes ever to leave this port.

The *Tashmoo*, a vessel of the Nelson Line, sails for San Farncisco. The sand, Captain O. Breiland said, is to be delivered at San Francisco and is to be used for moulding special pottery by a West coast firm. It is of special texture.—*Baltimore* (Md.) *News.*

Peculiar Accident Occurs Unloading Gravel

JOHN BARRY, one of the members of the Streator Graveling Co., Streator, Ill., that has the contract for graveling the roads of Minonk township, lost his right eye on the first day of the job. The gravel in the cars had been standing for a week and had become very dry. In dumping it into the pit for conveyance by belt to the waiting trucks, the pit became clogged. This placed an undue strain on the chain that connects the gas engine and the belt conveyor of the truck loader and the chain snapped in two. One end of the chain struck Mr. Barry in the eye and destroyed its sight.

South Carolina Places Orders for Domestic Cement

ORDERS for 1,100,000 bbl. of cement have been received by two local cement companies. The cement is for road construction work in South Carolina and will represent a cost delivered of approximately $2,-750,000.

The Pennsylvania-Dixie Cement Corp. has been awarded a contract for 600,000 bbl., Sales Manager W. J. Brown announced. Frank G. Conkling, Signal Mountain Portland Cement Company sales manager, announced that his company had received an order for 500,000 bbl.

The exact price cannot be determined, since the price varies dependent upon the point of delivery, the freight charges affecting the price. It is estimated, however, that the total will be somewhat around $2,750,000.

"The business is particularly desirable," Mr. Conkling declared, "since it will greatly improve our operating conditions. It is an especially attractive order, since the cement will be used in South Carolina, where construction operations can be carried on steadily practically the entire year.

"The cement will be delivered over a period of the next eighteen months. It will go to highway work in various parts of the state."

Mr. Conkling explained that the big order will probably result in increasing production rate at the plant of the company at the base of Signal mountain, where the entire order will be filled. He stated that the large capacity of the plant and the recognized quality of its product were determining factors in securing the order.

Mr. Brown of the Penn-Dixie explained that his company had not yet determined which unit of the company would fill the 600,000 bbl. order. The closest plant to this city is at Richard City.

It is pointed out that, regardless of which plant or plants have a part in furnishing the cement, the company as a whole will reap the benefits of the increased production it will bring. This order, too, will run through next year, Mr. Brown said.

The orders are perhaps among the largest ever booked for cement here or in this entire section. The cement will be used in connection with the $65,000,000 highway program in South Carolina, Mr. Brown explained.—*Chattanooga* (Tenn.) *News.*

New Limestone Quarry for West Virginia

THE establishment of a large limestone plant at Narrows, Va., by the Union Carbide Co. is planned for the near future, it was reported recently. It is said that the plant's production schedule calls for 100 cars of limestone each day, and that the cars will be hauled direct over the Virginian railway to Charleston, where the carbide company has a plant.—*Bluefields* (W. Va.) *Telegraph.*

Research Develops New Knowledge of Cement, Aggregates, Concrete

Annual Meeting of the American Society for Testing Materials

ONE of the outstanding committee reports at the annual meeting of the American Society for Testing Materials, Atlantic City, N. J., June 23-27, was that of Committee C-9 on concrete aggregates. The report itself contains 117 printed pages, and various technical papers presented in connection with it throw much new light on the nature of concrete. The report with its recommendations was accepted; those changes in specifications requiring it will be submitted to a letter ballot of the society before final action.

Proposed Changes and Additions to Specifications

A method of making flexure tests of concrete using a simple beam with center loading was adopted as a tentative standard. This is of considerable significance in connection with the investigations in progress concerning the effect of aggregate characteristics on flexural strength of concrete pavements. At the present time a large number of states are making such flexural tests and a standardization of such tests is a pressing need.

The changes in other specifications consist of slight revisions in the wording of the method of test for the field determination of apparent specific gravity of fine aggregate; the method for determination of approximate percentage of voids in fine aggregate; the method of testing for field determination of surface moisture in fine aggregate; and for methods of making and storing specimens of concrete in the field.

Activities of Subcommittees

A subcommittee under the chairmanship of Ernest Ashton (Lehigh Portland Cement Co.) is endeavoring to work out definitions or terms that will be commonly accepted. Another subcommittee under F. H. Jackson (U. S. Bureau of Public Roads) is studying abrasion of aggregates as a test of their quality for concrete making; the same subcommittee work included a supplementary report by A. T. Goldbeck (National Crushed Stone Association) on the effect of stone dust in the coarse aggregate on the strength of concrete; a report by Fred Hubbard (National Slag Association) on the relation of loss by abrasion and unit weight of aggregate to the concrete-making qualities of slag, whose conclusion and recommendation was that the abrasion test was of no value in the case of slag, and should be dropped.

The results of comparative study of a number of methods of determining moisture in concrete aggregates was reported by S. H. Graf (Oregon State Agricultural College). Most of the other work of the committee is concerned with phases of concrete making of more immediate interest to the engineer and designer than to the manufacturer of cement and aggregates.

Abrasion Test

Judging from the reports of F. H. Jackson and Fred Hubbard, already referred to, the abrasion test of aggregates stands a good chance of being soon discarded. Jackson's report was based on an assembly and digest of all available data showing what relations, if any, exist between the strength and resistance to wear of crushed-stone and gravel concrete, and the results of abrasion tests on the coarse aggregates employed; that is the standard Deval abrasion test in the case of crushed stone and the modified Deval abrasion test in the case of gravel.

Referring particularly to Goldbeck's (National Crushed Stone Association) tests, Jackson said in effect: "A slight indication that the strength of concrete is slightly affected by the abrasion loss on the aggregate . . . is more marked in the case of the tests reported by Goldbeck than in two other series (referred to), although, as indicated, this was the only series in which the proportions were adjusted so as to give the same cement content per unit of volume of concrete."

Jackson's conclusions were: "(1) That within the ranges of abrasion loss studied, the crushing strength of concrete is not affected by the quality of the coarse aggregate as measured by the standard Deval abrasion test; (2) that the data available were insufficient to warrant any definite conclusion as to the effect of abrasion loss of aggregate on the transverse strength of concrete; (3) that within the range of the abrasion losses studied, the resistance of concrete to wear as measured by the Talbot-Jones wear test is not affected by abrasion loss on aggregate."

In the case of crushed-slag aggregate Hubbard concluded, from a digest of the work of 17 laboratories, in the case of compressive strengths that high abrasion loss in slag is not an indication of inferior concrete-making qualities, but rather the reverse; that the slags of medium weight (70 to 85 lb. per cu. ft.) gave better compressive strengths than an extremely heavy slag with a weight of 100.4 lb. per cu. ft. In the case of flexural strengths all the slags (70 to 100 lb. per cu. ft.) gave entirely satisfactory results, regardless of abrasion loss; and that, generally, the heavier slags gave higher flexural strengths than the lighter slags. With regard to the wear of concrete, Hubbard concluded that when subjected to the Ohio State Highway Department wear test the concrete containing the heavier slag shows less wear than that made of the lighter materials, but that there was nothing indicated by the abrasion tests that is not more conclusively shown by the weight per cubic foot determination, and that there is a general relation between the weight per cubic foot of the aggregate and its abrasion losses, the higher weights being accompanied by lower abrasion.

Hubbard's "very definite conclusions" were: (1) That the weight per cubic foot determination of slag is an accurate test which enables individual laboratories to check very closely; (2) that the abrasion test on blast-furnace slag is unreliable and inaccurate, and should be abandoned forthwith.

Dust in Stone Aggregate

Goldbeck's report on "One-Year Tests on the Effect of Dust-Coated Stone on the Properties of Concrete" was in the nature of a supplement to that at the 1929 convention of the A. S. T M. In it he said "It should not be concluded, as a result of these tests, that in no case does stone dust produce harmful results in concrete. There are well authenticated cases of dust interfering with the bond between the coarse aggregate and the mortar. Evidently there are certain types of stone to which the dust clings tenaciously, notwithstanding the scouring action which takes place in the mixing process. Other stones, such as typified by that used in the present tests, are scoured during the mixing of the concrete and no bad effects are produced. Stones of this character, containing coatings composed of rock dust alone, which is easily displaced, probably are never harmful. Other stones from which the dust coating is not easily removed may produce bad effects. Each case is an individual one which should be judged on its merits."

Effect of Aggregates on Volume Change

Among the factors which influence volume changes in concrete due to variations in temperature is listed the character of aggregates. For example, from a summary of investigations made by Raymond E. Davis (University of California) concrete made with a quartz aggregate has nearly twice the coefficient of expansion of a concrete made with limestone aggregate. A table of the co-

efficients of concrete made with aggregates of different kinds is shown herewith:

Quartz	0.000 006 6
Sandstone	0.000 006 5
Gravel	0.000 006 0
Granite	0.000 005 3
Basalt	0.000 004 8
Limestone	0.000 003 8

Obviously a concrete with as low as possible a coefficient of expansion is most desirable for fireproof buildings, and for practically all concrete work, since changes in volume both because of variations in temperature and in moisture are destructive to the concrete.

Among the factors which influence volume changes due to variations in moisture are listed: Type and gradation of aggregate, and admixtures. Some conclusions of interest to aggregate producers are: Numerous investigations have indicated the important influence of type of aggregate. It appears likewise that the gradation of aggregate is not without its effect. Again, as in the case of temperature changes, limestone concrete has the least volume change, as the following table shows:

EFFECT OF TYPE OF AGGREGATE UPON VOLUME CHANGE (DAVIS)

Aggregate	Percentage Volume Change in Three Months Contraction in Air	Expansion in Water
Gravel	0.079	0.0074
Sandstone	0.075	0.0055
Limestone	0.039	0.0050
Granite	0.037	0.0131
Quartz	0.036	0.0094

From the data reviewed Davis concludes:

"1. Variations in type of mineral aggregate have a marked effect upon volume changes of concretes in which the aggregates are incorporated. Sandstone, trap, and gravel concretes may be expected to undergo volume changes 50 to 100% greater than limestone and quartz concretes subjected to similar moisture conditions.

"2. Regardless of the type of aggregate it appears that when a concrete is cured and stored by complete immersion in water the expansion while continuing to increase for a long period of time is always very materially less than the contraction of the same concrete when cured and stored in air, but there is a marked difference in the behavior of different aggregates with regard to the contraction in air as compared with corresponding expansion in water. Thus, a granite concrete which is subject to a relatively small air contraction has a high water expansion, while sandstone which has a relatively high air contraction exhibits a relatively low water expansion.

"3. The gradation of the aggregate while having a much less pronounced effect upon volume changes than has the mineral character of the aggregate, nevertheless appears to exert some influence on expansion and contraction. Particularly, it seems to be true that if the very fine material of the aggregate, such as that passing say a No. 200 sieve, be of a clay-like character, such material influences volume changes to a marked degree, but if it be of angular or crystalline character, such as is the character of stone dust, then the effect upon the volume change is slight."

A paper by R. E. Davis and H. E. Davis (University of California) on "Flow of Concrete Under Sustained Compressive Stress," which means the permanent deformation of concrete in structures under stress, stated that the character of the aggregate has marked effect. Also the grading has an effect, the smaller the fineness modulus the greater the flow. For the aggregates included in these tests, limestone concrete flows the least, while sandstone and basalt concretes flow the most. Granite and quartz concretes exhibit flows of intermediate magnitude.

Aggregates and Durability of Concrete

A tour of inspection by one subcommittee, during which numerous concrete structures in Canada, exposed to very severe weather conditions, were examined to determine the cause of faulty concrete, resulted in this conclusion: "That for the structures examined all of the defects observed could have been avoided by proper attention to four factors, quality of aggregate, quantity of cement, consistency of mix, and methods of placing. The committee was of the opinion that all engineers responsible for concrete design and construction should make similar inspection tours in order to study for themselves the common errors of the past, so that they may apply their ingenuity to a greater advantage in overcoming them."

Burned Clay Aggregates

Tests of plain and reinforced "Haydite" (burned-clay aggregate) concrete were reported by F. E. Richart and V. P. Jensen (University of Illinois). The concrete was made with sand fine aggregate and with all Haydite aggregate, fine and coarse. Comparisons were made with sand and gravel concrete and with sand and limestone concrete. Tests were made of both strength and workability. The following developed:

"1. The average unit weights of the fine and coarse Haydite used were respectively 54 and 43 lb. per cu. ft. by dry, loose measure and 62 and 47 lb. per cu. ft. by standard dry, rodded measure.

"2. Concrete was made with Haydite aggregates with no particular departure from ordinary methods. The same mixing procedure was used with Haydite concrete as with gravel and limestone concretes. With the consistencies used in Series 1, no difference was noted in the work required to place the concrete or in the appearance of the molded surfaces of beams made with gravel, limestone and coarse Haydite. The Haydite beams presented a harsher top surface, making finishing more difficult where no topping mortar was used.

"3. The proportion of coarse aggregate that may be used depends upon its size, whether the material by Haydite, gravel or limestone. The gravel and limestone used in these tests were of nearly the same size as the "C" Haydite. The usable proportion of any of these aggregates was limited by the ¾-in. maximum size. The ease of working and placing of concrete is also very largely dependent upon the aggregate size, but it is evident that the gradation and texture of the Haydite aggregates required a somewhat greater water-cement ratio than gravel aggregates in similar mixes.

"4. Because of the high water absorption by the Haydite, some difficulty was met in the choice of the proper allowance for absorption in determining the water-cement ratio. The absorption allowances used in all cases were those found by test for material immersed for one hour, namely, 7% for the coarse Haydite and 14% for the fine material. Had three-hour absorptions been used these values would have been about 8% and 18% respectively. Which of these amounts represents the actual condition in the concrete is debatable; it is clear that with such large absorption values, any error will have a large effect upon the water-cement ratio. It must be remembered that these percentages are based upon the dry weight of the light aggregates which are about one-half the weight of sand and gravel aggregates.

"The tests indicate that the absorption allowance for Haydite is not a fixed quantity but depends upon the moisture content of the aggregate as used.

"5. Concrete made with Haydite aggregates required greater water-cement ratios for the same mixes and equal slumps, and generally showed lower strengths than those with gravel aggregates. For equal water-cement ratios, however, the strengths of concretes made with sand and gravel, sand and coarse Haydite, and fine and coarse Haydite were very nearly equal. Any strength differences found may be explained as due to the effect of errors in absorption allowances upon the water-cement ratio. There is no indication that the strength of any of the mixtures was limited by the strength of the aggregate particles.

"6. The modulus of elasticity of Haydite concrete is markedly lower than that of gravel and limestone concrete of like proportions. For the considerable range of mixes and consistencies the values of modulus of elasticity for concretes made with coarse Haydite and natural sand are about 75% and for concretes made with all-Haydite aggregates about 55% of the values for sand—gravel concretes of equal strengths.

"7. The weight per cubic foot of the Haydite concretes used varied from 93 to 106 lb. for all-Haydite concrete and from 112 to 126

lb. for concrete made with sand and coarse Haydite. The range in weights is due to variations in mixtures and in proportions of fine and coarse aggregates used.

"8. The increase in compressive strength with age of moist stored Haydite concrete compares well with that for gravel concrete for periods up to 6 months.

"9. The ratio of bond resistance to compressive strength at the age of 28 days was essentially the same for like mixes of gravel and Haydite concrete.

"10. For beams without web reinforcement, which failed by diagonal tension, the ratio of the shearing unit stress of the compressive strength of control cylinders was practically the same for corresponding mixtures of gravel and Haydite concrete."

In the discussion of the paper the growing use of Haydite concrete for bridge floors was brought out. It was called satisfactory, but it was stated that much better than ordinary workmanship was required.

Cement Committee

The convention labors of Committee C-1 on cement were chiefly devoted to adopting a new constitution and by-laws, providing for a reorganization of the committee. The committee's report included the revised specifications for portland cement and the new specification for high-early-strength cements adopted by the committee shortly after the 1929 annual convention, both of which are now tentative specifications of the society. A part of the committee report dealt with new tolerances, agreed upon, in testing apparatus. No acceptable specification for natural or masonry cements was produced.

The activities of the Cement Reference Laboratory at Washington, D. C., were reported in detail. The major part of the laboratory's efforts have been devoted to field inspection of other laboratories, and the cement-testing equipment and methods used in them. Up to April 17, 1930, inspections of 125 laboratories in 36 states had been completed. The "batting average" of equipment inspected is shown below:

APPARATUS INSPECTED IN THE FIELD DURING INSPECTION OF 119 CEMENT-TESTING LABORATORIES

	Inspected	Approved
Moist cabinets	118	13*
Steam chests	117	57†
Balances for fineness	120	37
Balances for mixes	141	110
Weights for fineness, pieces	803	772†
Weights for mixes, pieces	1537	1485†
Graduates	299	261
Vicat apparatus	141	42†
Gillmore needles, pairs	147	99†‡
Briquet molds	4578	3155†
Tension testing machines	127	50¶
Total	8128	6081

*Includes only apparatus with automatic temperature controls.

†Includes apparatus satisfactorily adjusted during inspection.

‡Since January 1, 1930, tapered shank needles have not been approved on basis of micrometer measurements.

¶Some machines were approved when grips were not in strict accordance with specifications, but were of type and dimensions calculated to secure the intent of the specifications

These inspections have developed some interesting knowledge of the habits of testing engineers and specification writers, as the following extracts show: "In some laboratories, where methods and apparatus may otherwise be relatively good, there is the disposition to consider some part of the specifications and methods of testing as not satisfactory, at least in wording, and to make some departures from the requirements specified, with the idea of improving on the specifications or methods, or perhaps, better securing the real intent of the specifications. Such deviations from the standards specified may account for some of the disagreement in test results, and they perhaps hinder the concentration of attention on points in specifications which merit study."

Differences in Cements Emphasized

While much of the reports, papers and discussion tended to show and to prove the many variable factors in cement testing, there was, as usual in the past recent years, a tendency to lay stress on variations in the cement itself. There was also evidence of a distinct difference of opinion, among cement users, as to whether the new high-early-strength cements, and the finely ground cements, are really improvements over the old standard portland cements.

In the report of Committee C-9 on aggregates, as already noted, the summary of investigations of volume changes in concrete due to temperature differences, Davis assigns "kind of cement" as one. Some of his conclusions were:

"The thermal coefficient of expansion per 1 deg. F. for neat portland cement varies somewhat with the brand. The tests here reviewed indicate that the coefficient varies between the limits 0.0000083 and 0.0000096. The thermal coefficient of expansion for neat cement is appreciably greater than for a normal cement mortar and concrete using any of the aggregates commonly employed."

Where volume changes are due to variations in moisture, the effect of composition and fineness of the cement is even more important, according to Davis' conclusions:

"It appears that with specimens in the form of neat-cement bars, the brand of cement and the fineness of grinding have an appreciable effect upon the volume changes both in the shrinkage which occurs during air storage and in the expansion which occurs during water storage. In one series of tests at the age of one year the expansion among the several cements varies from 0.07 to 0.15%, and similarly contraction among the several cements varies from 0.18 to 0.34%.

"The finer the cement the larger the expansion accompanying water storage both for neat-cement and for 1:3 mortar bars. Tests indicate that regrinding may increase this expansion by at least 10%.

"The chemical composition of the cement may exert a marked influence upon volume changes. A high gypsum content is undesirable since it materially increases the expansion under conditions of moist storage. Tests indicate that the addition of 2.5% of SO_3 in the form of gypsum may double the expansion of a given cement.

"The indications are that among normal portland cements (not including the high-early-strength portland cements for which no data are available), the volume changes which will ultimately take place in a normal concrete are not greatly different for one cement than for another. That is, for cements of the same fineness of grinding which will pass the standard tests for a portland cement, a concrete using one brand exhibits approximately the same volume changes under given conditions as does the same concrete using another brand of cement."

C. H. Scholer and L. H. Koenitzer (Kansas State Agricultural College) reported "A Study of 14 Brands of Portland Cements and 4 Early-Strength Cements." This study was made specifically to determine the variations between various brands of cements. The properties studied were chemical and physical properties, the compressive and flexural strengths in mortar and concrete, the workability or consistency as expressed by slump and flow, the water-cement-ratio-strength relation for each cement through a narrow range, and the mortar voids characteristics of each brand.

In justification of this investigation the authors state: "The question has often been raised whether certain brands of cements have certain characteristics which makes one brand of cement more desirable than another. A study of different brands of cements over a period of years indicates that the concrete-making qualities of each brand of cement might be different. In actual paving construction work, inspectors have noted a difference in the amount of water required for different brands of cements, as well as a difference in the workability of the cements. The work done during this investigation was based primarily upon highway uses and requirements."

The authors' conclusions are as follows: "The authors make no attempt to draw any conclusions from the results of the chemical analyses or their relation to the physical properties.

"The normal-consistency determination for these cements varied but little and the operators following the specified methods closely were able to get consistent checks. It was observed, however, that there was a very marked variation in the consistency of the standard mortars when made up using the quantity of water indicated by the normal consistency. It is the opinion of the authors that the determination of normal consistency is of doubtful value for indicating the quantity of mixing water to be used.

"The flexural strengths of the concrete were fairly uniform, whereas the compressive strengths showed a wide variation. Sev-

eral brands of cement that gave the higher flexural strengths gave the lower compressive strengths.

"The chief variation in the various brands studied seem to be to their sensitivity to small variation in water content in the mortar mixes at basic water content and above. Some cements showed in this investigation but little loss in strength with added water content, while others show a very sharp decline in strength. The extent of this investigation is not sufficient to determine whether the variations shown are characteristic of the respective brands, but some field data very definitely confirm this for mortar concretes. Additional cement of the brands showing the most markedly different characteristics are being secured for further study, which should definitely show the extent of this variation and whether or not it is a distinct characteristic.

"The authors have restricted their conclusions to the standard portland cements. Of the early-strength cements, three were portland cements and one was a high-alumina cement. The early-strength cements seemed to be more plastic and workable than the normal portland cements. The high-alumina cement required water in considerable excess of basic to give the maximum strength in the mortar mix."

In the discussion following the presentation of the paper there appeared to be considerable skepticism of the results and conclusions.

Rate of Hydration of Clinker

F. O. Anderegg and D. S. Hubbell (Mellon Institute of Industrial Research) continued their paper of last year as Parts II and III, synopses of which follow:

"*Part II.*—Standard portland cement particles, whose earlier reaction rate had been previously reported and whose original dimensions were 15 to 25 microns, were found to be approaching apparently complete hydration in nine months, while at twelve months hydration was practically finished. A white portland cement and an early-strength portland cement seemed to reach a similar degree of hydration in a shorter time.

"*Part III.*—The hydration rate of tricalcium aluminate was found to be quite high, particles of a dimension of about 25 microns being about three-quarters hydrated in 3 hours. Tricalcium-silicate particles of the same size required about 7 days for a similar degree of hydration, while with dicalcium silicate this amount of hydration was reached only after 5.5 months. The early rates for the portland cements studied appeared to be intermediate between those of the two silicates. In general, mixtures of minerals reacted more rapidly than single minerals. This was true especially for the mixture roughly approximating the portland cement in composition."

It was stated that the object of the study was to determine the best size of particle, taking all the various factors into consideration. Contrary to other opinions frequently expressed, the authors stated definitely that the strength of extraordinarily fine-ground cements went on increasing with age the same as standard cement. They stated that there was a large field for research in grinding in order to solve the problem of the most efficient grinding for maximum cementing power in the resultant cement.

Discussion brought out a contrary opinion regarding the merits of extraordinarily fine-ground cements—that constructors were now sacrificing permanency to speed of construction—that size distribution (grading of clinker particles or cement) had an enormous influence on the strength of the resulting concrete.

Steam-Curing for Resistance to Sulphate Waters

Dalton G. Miller (University of Minnesota) in a paper "Strength and Resistance to Sulphate Waters of Concrete Cured in Water Vapor at Temperatures Between 100 and 350 deg. F." suggests a method of curing concrete drain tile and other concrete products to increase their resistance to disintegration in sulphate waters. The 2x4-in. mortar and concrete cylinders were tested by submersion in Medicine Lake, S. D. His conclusions were:

"Based on tests of 2 by 4-in. concrete cylinders made of graded aggregate with fineness modulus of 4.67, mix 1:3, and water ratio 0.59 to 0.64, the effects on strength and resistance to sulfate waters of curing in water vapor at temperatures between 100 and 350 deg. F. following 24 hours in moist closet at room temperatures of 68 to 75 deg. F., when compared with tests of check specimens cured continuously in water at room temperatures, following 24 hours in moist closet, have been as follows:

"1. Concrete after curing 12 to 24 hours in water vapor at temperatures between 100 and 350 deg. F., followed by storage in dry air at room temperatures, has a compressive strength at 7 days about equal to that of 7-day concrete cured continuously in water at room temperatures.

"2. Increase of length of time of curing beyond 48 hours has little influence on the compressive strength of concrete cured in water vapor at temperatures between 100 and 350 deg. F. and concrete so cured ordinarily attains a maximum and fairly constant strength 80 to 90% of that of 28-day concrete cured continuously in water at room temperatures.

"3. Based on the 7 and 28-day and such 1 and 5-year tests as are now available, it appears that concrete cylinders stored in a water following curing in water vapor between temperatures of 100 and 285 deg. F. continue to increase in strength at a rate not essentially different from that of check cylinders cured in water at room temperatures although there is a slight retardation somewhat dependent on both temperature and length of curing periods.

"4. For curing periods of equal lengths, variations in temperatures between the limits of 100 and 350 deg. F. have no pronounced influence on the strength of concrete although the specimens made with fresh cements tested consistently stronger when cured at 155 deg. F. than at the other temperatures and, for the cements that had somewhat deteriorated during storage, specimens cured at 155 deg. F. tested but 13% weaker than those cured at the maximum temperature of 350 deg. F. These statements are based on curing periods up to 8 days for temperatures between 100 and 350 deg. F. and up to 32 days for temperatures of 100, 155 and 212 deg. F.

"5. For highest compressive strength of the concrete, the most favorable time for applying water vapor at temperatures of 100, 155 and 212 deg. F. is apparently 12 to 24 hours after making. No data are available for the other temperatures.

"6. The reaction of concrete made of portland cements from different mills to curing under these special conditions is essentially similar for both strength and resistance to sulfate waters.

"7. Concrete made of all the cements used in the strength tests showed retrogression of strength for some time period while curing in water vapor at some temperatures between 100 and 350 deg. F. Occurrence of this phenomenon was most frequent and generally of greatest magnitude in those groups of cylinders cured 96 hours at 260 and 315 deg. F. with the result that the tests were more uniform at 100, 155, 212 and 350 deg. F. than at either 260 or 315 deg. F. This statement is based on results obtained with cylinders made of 22 brands of cements of which 10 were used separately and 2 in combination.

"8. Concrete cylinders made of cements that had deteriorated in storage consistently tested lower in strength than did cylinders made of fresh cements for similar curing conditions although this difference was not great for temperatures above 212 deg. F. and curing periods of 4 days.

"9. With some exceptions, those cements that deteriorated most rapidly in storage, as indicated by strength tests of cylinders following curing at all temperatures for the shorter time periods, were the ones that displayed greatest resistance to the action of sulfate waters. This statement is made as indicative only of trend.

"10. Curing in water vapor at temperatures between 100 and 190 deg. F. did not generally increase resistance of concrete to the action of sulfate water; on the contrary, in some cases a decrease was indicated.

"11. Curing concrete in water vapor at temperatures of 212 deg. F. and upward markedly increased resistance to the action of sulfate waters with the data definitely indicating increase of resistance with in-

crease of curing temperatures between 212 and 260 deg. F. for a 12-hour curing period.

"12. Curing concrete in water vapor at 212 deg. F. has been more effective in developing resistance to the action of sulfate water when continued for 6 days than when continued but 2 days.

"13. Data are not yet complete enough satisfactorily to correlate curing temperatures and lengths of curing periods with resistance to sulfate waters of concrete cured in water vapor for all temperatures between 100 and 350 deg. F. although, within the limits of the experiments completed, it is significant that for temperatures between 100 and 260 deg. F. those specimens cured at the highest temperatures and for the longest periods have made the most favorable showings.

"14. Absorption of concrete cured in water vapor at high temperatures is not a criterion of resistance to sulfate waters."

Workability of Concrete

One subject of hardly less interest to the cement and aggregate producers than to users of concrete was the progress being made to develop real information on workability.

W. F. Purrington and H. C. Loring (New Hampshire State Highway Department) reported further on their studies on the workability of concrete, presented in 1928. They have developed a vertical shaft concrete mixer equipped with apparatus for measuring the power consumed in mixing concrete batches and have thus obtained a fairly accurate and constant measure of actual workability in terms that mean something to the user of concrete. Their results showed that there is a relation between the power consumed in mixing concretes made of various cements and the flow numbers of the cements. The authors experimented with 15 brands of cement and came to the conclusion that there are vast differences—over 100% in the workability of concretes made under like conditions from the various cements. The authors stated that engineers could well afford to take advantage of these differences in workability, because degrees of workability mean much in economy of placing concrete.

Two methods, or devices, for measuring the consistency of concrete in the mixer were also described at the meeting, one of them developed by Mr. Perry, of the Pioneer Sand and Gravel Co., Seattle, Wash., for use in that company's ready-mixed concrete plants.

Gypsum, Lime and Plaster

Committee C-11 on gypsum reported several recommended changes and additions to the society's specifications, including a tentative new specification for gypsum sheathing board. The committee report also contains the results of a comprehensive investigation of the properties of gypsum fiber concrete, which is defined as "a combination of an aggregate consisting of wood shavings with gypsum." Two series of tests were reported. The specimens in the first series consisted of cast cylinders. Those used in the second series consisted principally of specimens cut from cast slabs with enough cast cylinders to develop the relation between the two types. Weights per cubic foot were determined; the compressive strengths; the modulus of elasticity; the modulus of rupture. In other words needed data for the use of building designers have been developed.

The conclusions giving these data are:

"Compressive strength:

1. (*a*) Gypsum fiber concrete with 3% chips, of the consistencies used in practice, had a compressive strength of from 800 to 1300 lb. per sq. in.

(*b*) Gypsum fiber concrete with 12.5% chips, of the consistencies used in practice, had a compressive strength of from 450 to 600 lb. per sq. in.

2. Specimens tested after storage at 70 deg. F. and 80% relative humidity showed strengths averaging 77% of the bone dry strengths.

3. Cut cylinders and cut prisms had equal strengths.

"Modulus of rupture:

4. (*a*) Gypsum fiber concrete with 3% chips, of the consistencies used in practice, had a modulus of rupture from 210 to 310 lb. per sq. in.

(*b*) Gypsum fiber concrete with 12.5% chips, of the consistencies used in practice, had a modulus of rupture from 110 to 170 lb. per sq. in.

"Modulus of elasticity.

5. (*a*) Gypsum fiber concrete with 3% chips, of the consistencies used in practice, had a modulus of elasticity from 580,000 to 850,000 lb. per sq. in.

(*b*) Gypsum fiber concrete with 12.5% chips, of the consistencies used in practice, had a modulus of elasticity from 200,000 to 300,000 lb. per sq. in.

6. A 7-day test under suitable drying conditions can be used to indicate the quality of the materials employed."

Lime

There was no formal meeting of Committee C-7 on lime, but several members present met informally. One paper in the report of Committee C-9 on concrete aggregates—Davis on volume changes in concrete, already referred to—contains some interesting information for lime producers (on the effect of admixtures):

"The influence of lime as an admixture upon concretes and mortars as indicated by the expansion of 4 by 4 by 24-in. bars immersed for 24 hours subsequent to 7 weeks of air storage is reported by Scofield and Stinchfield (29). The lime content varied from 0 to 15% of the cement by weight for both mortar and concrete specimens. The expansion accompanying immersion increased with the quantity of admixture, varying from 0.017 to 0.020% for concrete specimens and from 0.019 to 0.022% for mortar specimens. The kind of lime is not reported.

"Tests by Davis and Troxell (56) indicate that an admixture of high-calcium hydrated lime into a basic 1:3 cement mortar has no appreciable effect upon the shrinkage. In these tests various amounts of hydrated lime up to an amount equal in volume to that of the cement were employed. After 28 months in dry air storage the contraction for the various groups varied from 0.15 to 0.16%.

"A second series of tests by Davis and Troxell, similar to those described in the preceding paragraph, was made to determine the effect of the same lime used as an admixture upon mortars cured in air for 7 months and then stored in water. After a period of more than 3 years, when all changes in length had apparently ceased, there was observed a residual shrinkage of 0.04 to 0.06% or approximately one-third that which took place in air prior to immersion. While the expansion accompanying immersion was greatest for the mortar with the largest lime content and was smallest for the mortar containing no lime, the difference was not marked.

"Tests made by White (14) and by Davis and Troxell (56) to determine the effect of integral waterproofing compounds indicate that of those tested none aided in reducing the volume changes from alternate wetting and drying of cement mortars.

"Conclusions.—The following conclusions in respect to effect of admixtures have been drawn:

"1. High-magnesium hydrated lime used as an admixture in cement mortars appears to have little effect either upon the shrinkage accompanying air storage or upon the expansion accompanying water storage.

"2. In general, the use of integral waterproofing compounds is not effective in preventing or reducing volume changes in concrete.

"3. The substitution of a dolomitic or high-magnesium lime for cement in small quantities up to 10% of the weight of the cement reduces the contraction of mortar bars stored in dry air. Similar substitutions of clay for cement, the clay being intimately ground with the cement, indicates that the volume changes increase as the clay content increases."

Plaster

The new sectional committee on specifications for plaster gave an account of itself, and reported that its scope had been enlarged to include outside plaster or stucco, as well as interior plastering. It will organize with subcommittees on lime, gypsum and cement plaster. The subcommittees on lime and gypsum plasters are already organized.

Business Conditions in the Construction Industries

IN A GENERAL SUMMARY of business conditions issued June 28 by Julius H. Barnes, chairman of the National Business Survey Conference, he has this to say about the construction industries:

Reports from state leagues in 21 representative states indicate that the improvement in the financial situation of building and loan associations continues. The majority report sufficient funds to meet the demand for desirable loans. Withdrawals generally are decreasing and in many instances are now normal. Receipts are somewhat below those of a year ago, but in most states are reported to be increasing.

Rates for first-mortgage money are now very uniform, prevailing rates being 5½% to 6%. In only one state are rates reported higher now than a year ago.

Data available indicate foreclosures and delinquencies on mortgages, both farm and city, were materially reduced in May as compared with May, 1929, and May, 1928.

Companies with about four-fifths of the total mortgage loans of life insurance companies report that at the end of May their loans aggregated $5,904,000,000, against $5,791,000,000 on December 31 last.

For the year to June 20; non-residential building was less than last year by a little more than $110,000,000, or 9%; public works and public utilities exceeded last year's volume by a little over $110,000,000, or approximately 20%; but residential building fell behind nearly $500,000,000. The comparative figures for contracts awarded during these periods were: Non-residential building—this year, $1,136,000,000 against $1,246,000,000 last year; public works and public utilities—this year, $684,000,000 against $572,000,000 last year; residential building—this year, $554,000,000 against $1,045,000,000 last year.

Total building contracts for all classes this year to June 20 were $2,375,000,000, against $2,864,000,000 for 1929 and $3,275,000,000 for 1928. (The building contract figures are from the F. W. Dodge Corp.)

May permits for additions, alterations, and repairs in 295 cities show 2% increase in value for May over April, and April for these same cities was 7% greater than March.

Awards of concrete pavement to June 14 totaled 73,925,716 sq. yd. as compared with 65,473,233 to June 15, 1929, and 71,446,653 to June 16, 1928. Contracts awaiting award are 24% above 1929 and 11% above 1928 on the same dates.

Concrete road yardage continues to exceed by a substantial margin road awards in any previous year, being 27% greater than 1929 and 21% greater than 1928. Street and alley yardage still falls short of previous records in nearby years.

Shipments of cement in May increased 30% over April and 3% above May, 1929. Production exceeded shipments only slightly.

The lime industry is more than 13% below last year. Shipments of chemical lime are at the same level as last year, but the demand for lime for construction purposes continues low. Agricultural lime is dormant at this season.

Shipments of crushed stone, sand and gravel are running 5% to 10% below the same period of last year. The demand for road construction purposes is about the same as last year, but railroad ballast orders have been considerably curtailed.

The average price index for building materials shows a slight softening in June as compared with May for sand, crushed stone, cement, common brick and lumber, with gravel, structural steel, and hollow tile remaining firm or increasing slightly.

Economics of Crushed Stone Production

THE CRUSHED STONE INDUSTRY has experienced remarkable expansion, production increasing about 140% in the past 20 years, from 39,215,575 tons in 1909 to 91,265,360 tons in 1928. Every industry is confronted with the usual general problems of production, transportation, and marketing, but an industry of this magnitude with production centers scattered throughout the entire country is faced with many complex problems peculiar to itself, the solution of which requires an intimate knowledge of all the circumstances and conditions on which success depends.

The United States Bureau of Mines now has in preparation a report covering the economies of the crushed stone industry. The subjects discussed will be capital investment, the importance of adequate prospecting, testing to determine adaptability to use, factors affecting production costs, methods of quarrying and preparation, marketing problems, competitive conditions, transportation, and selling prices.

The purpose of the report is to encourage operators to devote adequate study not only to the physical process of quarrying, crushing, and transporting stone, but also to the more complex problems of competition, marketing, selling price in relation to production cost, quality and adaptability of the product, and the present and future trends of the industry. Charts are being prepared showing the growth and development of the industry in the various states during the past 21 years. The successful promotion of new enterprises demands a review of all the factors covered in such a report, and an important purpose of the paper is to encourage so careful a study of the conditions surrounding proposed developments that many unwise ventures will be arrested in their early stages, thus preventing unnecessary disappointment and loss.

Moline (Ill.) Gravel Operators Offer State a Settlement of Controversy

NEGOTIATIONS for the settlement of the road controversy, growing out of the encroachment of gravel pits of Moline material dealers on the old river road bed near Cordova, Ill., are under consideration, it is said and the plans for the settlements have been forwarded to Springfield, where the state highway commission and highway engineers are to pass on them shortly.

A year ago, when the old river road was endangered by the gravel pits the material dealers made an agreement with the county board, whereby a new right-of-way was furnished, and the owners of the pits paid the expense of moving and relocating the road.

But because of the state plans for a hard road through that section of the county, Route No. 80, and the danger of further encroachment on the highway there, injunction proceedings were brought several weeks ago seeking to enjoin the operation of the gravel pits in such a manner that the county roads would be endangered.

Now it is learned that the material companies, named in the injunction proceedings, particularly, the Moline Consumers Co., owner and operator of the gravel pits, have offered to purchase for the state a right-of-way.

While the details of the proposed settlement are not given out, it is said there would be two slight south turns in the highway there to complete the safe road.

Acceptance of the compromise will depend now on the attitude of the state highway authorities, but those in a position to know feel confident that the matter will be settled out of court and that the gravel pits will be allowed to operate with a free hand by providing the new right-of-way.

Settlement of this road controversy will be the signal for erection of the gravel washing plant contemplated by the Consumers Co., at the site of the gravel pits, as was announced last spring, which would enable that company to prepare its building material on the ground and bring only the prepared and sorted materials to the Moline yards for local distribution, and to ship materials direct from the washing plant to other points.—*Davenport* (Ia.) *Times*.

Building Code Tabulation

THE DIVISION OF BUILDINGS AND HOUSING, Bureau of Standards of the Department of Commerce, has presented information compiled from questionnaires sent out during the early part of 1930 to building inspectors, city clerks and other municipal officers. The questions pertained to the operation or absence of a building code and other information regarding revisions and methods of revisions. The mimeographed report is free to interested parties.

Calgary Plant of Gypsum Lime and Alabastine in Operation

THE new Calgary plant of Gypsum, Lime and Alabastine, Ltd., Paris, Ont., has recently been opened and is now producing various lines of construction materials with sufficient orders ahead to keep it busy until well into the autumn, according to an announcement to the *Toronto Mail and Empire* by officials of the company.

The plant is employing about 20 men, having been in operation for about a month in one department and only a fortnight in another. Lime, plaster, tile and blocks are now being made.

It is a smaller plant than that operated in Winnipeg but is said to be the most efficient unit of its kind in the string operated by Gypsum, Lime and Alabastine. It was designed to eliminate less efficient factors noted in similar plants.

During its past year, the company spent a considerable portion of its earnings in acquisition of new units in Ontario and Quebec. Part of the cost of the Calgary plant will be charged to this year's earnings. Last year the company's operating profits were $1,315,315, which worked out at $2.07 per share, as against $977,591, or $1.42 per share the year before.

Sales this year will experience a falling off in some departments, but an average good year is expected and the effect of the season ahead of the new plant in Calgary, combined with the first full year's business of 1929 acquisitions, may result in a higher gross income for 1930 than in the former period. Apart from the Calgary plant, five units were added in 1929. The company's research department is continuing its work in creating new products from the raw materials controlled by the corporation and in adding new uses for lines already in production. In addition to its domestic business, the company exports to more than 35 foreign countries.

New York Central Extends Container-Car Service to Aggregates

WESTCHESTER COUNTY, where, it has been said, more money is annually spent per capita for new construction than in any other comparable group of suburban communities in the United States, has been provided with building material delivery facilities on a par with those of New York City, writes Allen E. Beals in the current *Dow Service Daily Building Reports.*

After a long wait for the building construction situation to warrant the expenditure, the New York Central Railroad Co. has extended the container-car facilities that have been in successful operation in New York City to Westchester County and Mount Vernon has been selected to be the central distributing point for the distribution of common brick, cement, lime, sand, gravel and broken stone shipped in containers direct from railroad cars to dealers' trucks, thus serving the towns of Scarsdale, Hartsdale, White Plains, Tuckahoe, New Rochelle, Portchester, Rye, Pelham, Tarrytown and other points in south-eastern Westchester county.

"The installation of our $12,500 four-speed crane at Mount Vernon," said S. J. Gilmore, of the container car department of the New York Central Railroad Co., "has long been contemplated, but the company deferred its purchase until it became apparent that prospective building activity seemed to warrant the expenditure.

"That the turn has finally come is shown by the fact that we have been handling, since the crane was placed in operation a short time ago, an increasing volume of building materials reaching the peak with 40,000 common brick a day last week, and the company has just bought three more cranes of similar cost and capacity to handle the increasing volume of material for new Westchester county building construction that has come into prospect since the first experimental crane was installed.

"Since the rate for container car delivery at Mount Vernon is only ten cents above the New York City rate, it restores to Hudson River common brick manufacturers the rich southeastern Westchester county market that in recent years has been dominated by Connecticut common brick manufacturers depending upon barges to ship to unloading docks in that part of suburban New York, and it is expected that a similar turn in markets will accrue to cement, lime, plaster, sand and gravel producers operating plants in the Hudson Valley."

William H. Barnes, of Barnes, McNamara and Morrissey, cargo brick distributors, representing in this city the bulk of the Hudson River common brick producers, when asked to comment upon the changed conditions brought about by the New York Central Railroad Co.'s selection of Mount Vernon as the central building material distributing point in southeastern Westchester county via container cars, said:

"I can say that I have noticed within the recent past a little better demand for common brick for delivery in Westchester county. Certainly the extension of the container car facilities to Westchester county gives back to the Hudson River common brick manufacturers practically a lost market and one that now can be well served by them."

Wheelbarrows

A GENERAL conference of manufacturers and users of wheelbarrows adopted and have approved for promulgation by the Department of Commerce recommendations which limit the stock sizes of wheelbarrows to those shown in Simplified Practice Recommendation No. R105-29 that has been published by the Bureau of Standards. This paper is for sale by the Superintendent of Documents. Price, 10 cents.

Contractors Continue Work on Credit Bureaus

NATIONAL ESTABLISHMENT of sound credit policies for the entire building construction industry is expected to be effected through one of two alternate promotional plans tentatively agreed upon by the ways and means committee of the Allied Building Construction Industries at its meeting here June 23, according to Edward J. Harding, a member of the committee and assistant general manager of the Associated General Contractors of America.

Both plans adequately provide for organizing, financing and maintaining nationally affiliated local credit bureaus in every important city of the country, Mr. Harding states. The plans will be submitted, July 22 and 23 at Chicago, to the next conference of the Allied Building Construction Industries, comprised of some fifteen or more independent national associations of general contractors, subcontractors and building supply dealers united for the co-operative utilization of both selling and buying power in the enforcement of standard credit policies.

The ways and means committee, made up of Mr. Harding, Frank Dunning, of Cleveland, representing the National Builders' Supply Association, and Edward McDonnell, of Detroit, representing the Contracting Plasterers' International Association, also expects to work out prospective budgets required to achieve specific objectives and to submit them to the Chicago meeting. The committee was appointed at the meeting of the Allied Building Construction Industries, June 5, at Cleveland, when the nation-wide campaign to eliminate loose credit practices was launched.

One of the plans worked out by the committee contemplates the raising of a revolving fund through the participating national associations, which fund would be used to train field men and organize the local units and which would be repaid when the local bureau became self-supporting.

The alternate plan would utilize the services of staff members of the various participating associations in promoting the local bureaus and placing them soundly on their own resources. Each plan provides for a managing director of credit bureau promotion to guide and coordinate the efforts of the field men and their relations with the Bureau of Contract Information, Inc., at Washington, which is to serve as a national clearing house of construction credit information.

The committee is to confer again before the Chicago conference and will develop further details in what contractors and building supply men generally believe to be the most important promotional drive that has been undertaken in the building construction industry in years.

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Manufacturing Methods at Large Concrete Pipe Plant

American Concrete Pipe Company, Oakland, California, a Modern Concrete Products Development

THE AMERICAN CONCRETE PIPE CO., with main offices at 615 Broadway, Los Angeles, Calif., is the successor to the Western Concrete Pipe Co. and the Bent Concrete Pipe Co. This company has plants at Los Angeles, Oakland, San Diego, Calif.; Tacoma, Wash.; Fort Worth, Tex., and Phoenix, Ariz.

The Oakland plant is located at 19th and Estuary streets, and can ship by truck, rail

Storage pile elevator served by track hopper and used for handling aggregate

or by boat, as dock facilities are available for loading boats for coastal or even foreign shipments of concrete pipe. The main line of the Southern Pacific railroad passes the plant. Cars can be switched about the company yard by a Holt tractor.

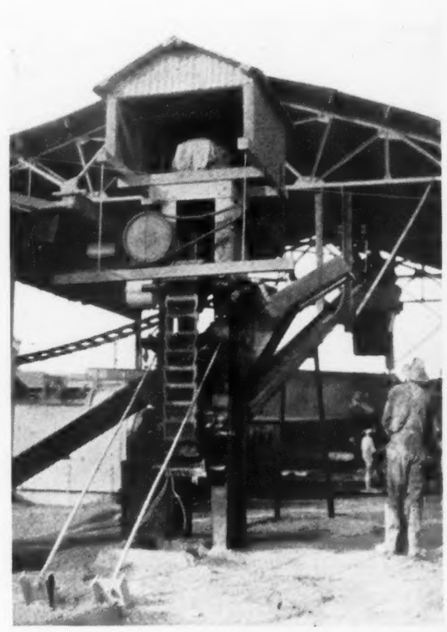
About 100 men were employed at the time the plant was visited, which included several on construction work, shipping, trucking, manufacturing, office and laboratory. The company does not at present employ a chemist for physical testing, but does have a neat and well equipped laboratory for the use of state or other inspectors.

The plant was then working at capacity, two shifts per day, making large diameter pipe mostly. The pipe is used for carrying water for city, industrial and irrigation uses, and is built to withstand reasonably high hydrostatic pressures. The company has testing equipment available for making hydrostatic and crushing tests of its products.

The plant was preparing to manufacture concrete pipe for the city of Oakland, 84 in. in diameter with a 9-in. wall. An 8-ft. section weighs 9 tons. The pipe is used for a storm sewer outfall into the bay.

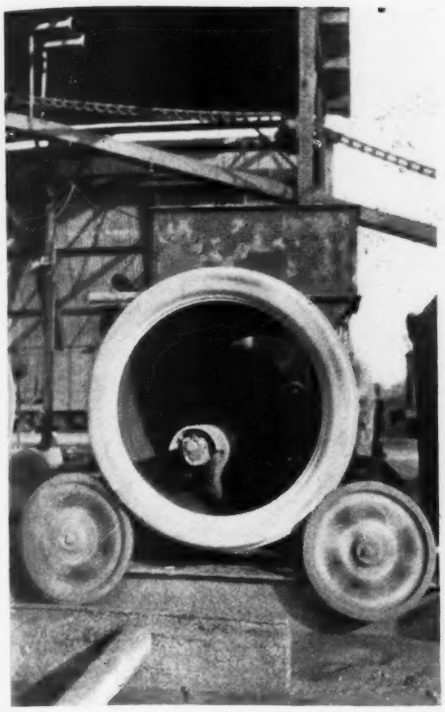
Columns and Piles Also Made

The plant's output is confined to concrete pipe, although some columns for structural purposes have been made, as well as concrete



Drag conveyor delivering concrete to hopper over portable screw conveyor

Here is where the longitudinal reinforcing rods are fitted to the cages



Portable screw conveyor filling the form while it is rotated

piling. Piling has been made up to 32 ft. in length.

The aggregate used consists of 50% sand and 50% of approximately ½-in. crushed rock. No admixtures are used. The aggregate is delivered to the plant in standard-gage gondolas and discharged to a track hopper serving a bucket elevator which discharges by chutes to ground storage. The sand and gravel is reclaimed by an 18-in. belt conveyor running into a tunnel under the stockpiles. The conveyor delivers to a small bin ahead of the mixer. The elevator, belt conveyor and mixer require a 35-hp., 15-hp. and 25-hp. motor, respectively.

The bins serve an "Aggremeter," a volumetric measuring device. Sacked cement is used. Water is added to secure a 1½-in. to 2-in. slump, although the water-cement ratio is not vital in this process, as the spinning squeezes out 80 to 85% of the water later. The ½-yd. "Agro-Vine-Sill" mixer discharges to a series of drag conveyors that elevate the concrete to a steel hopper mounted at sufficient elevation to discharge by gravity to the pipe form feeder. The mixer handles about 15 batches per hour.

The plant uses three Hume machines and

Assembling the mold

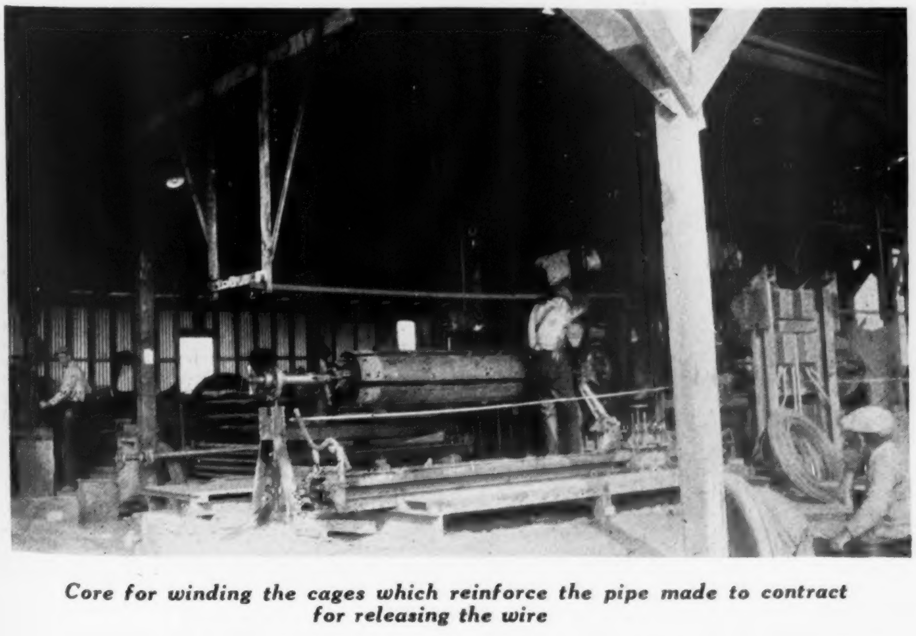
has a capacity of 1400 lin. ft. per day of 15-in. to 84-in. concrete pipe. The three pipe units are each driven by a 50-hp. motor through a No. 6 Reeves transmission and operate at 357 r.p.m. A small unit located in the yard for making small diameter pipe

Electric crane handles forms over the spinning machines

is driven by a 35-hp. motor through a No. 5 Reeves drive. The small unit operates at 321 r.p.m.

The feeder consists of a steel hopper serving a short screw conveyor. This hopper and conveyor are mounted on car wheels on the deck of a broad-gage transfer car. The transfer car takes care of movement from mold to mold, and the mounted conveyor takes care of movements necessary to deliver the concrete uniformly the length of the pipe.

Steel forms are mounted on driving wheels which are first rotated at a slow rate of speed, producing only enough compacting force to keep the concrete in place and to permit of such movement in the concrete that it will adjust itself to produce a uniform thickness in the wall of the pipe. The centrifugal force, during this initial spin, centers the steel reinforcement cage. When all of the concrete has been placed in the form, the forms are then rotated at the high speed which has been predetermined to produce the greatest compacting force without segregation of materials. About two minutes is required to place the concrete for a 45-in. pipe. The length of the so-called first spin varies from 8 to 15 minutes, according to the aggregate used, the temperature and other working conditions. Any bits of wood and other material of very light specific gravity are forced by centrifugal force to the interior of the pipe and are expelled with the excess water. After the initial spin is concluded the excess water is drained from the pipe by removing the water rings and foreign light materials. During the first spin



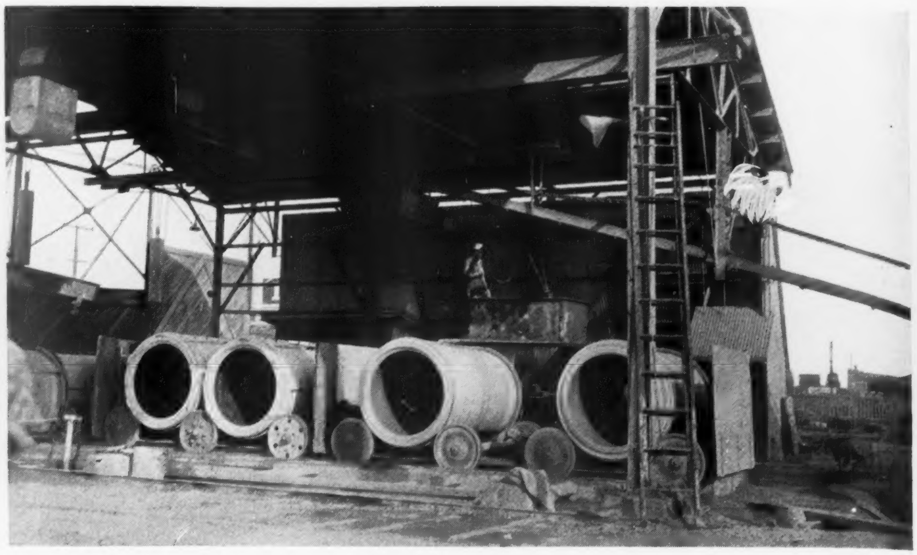
Core for winding the cages which reinforce the pipe made to contract for releasing the wire

the concrete takes a mechanical set, due to compacting. Its density is such that no impression can be made on the concrete by ordinary pressure upon the surface. The second spin of the pipe in the forms averages three minutes, and the purpose of the second spin is to produce a smooth interior surface after the water has been removed.

Removing the steel frame

During this spin the pipe is burnished with a round steel rod and the result is a pipe of unexcelled smoothless. After the final spin has been completed the pipe is moved in its form to a steam room where it is cured from 8 to 12 hours in a saturated atmosphere of low temperature steam.

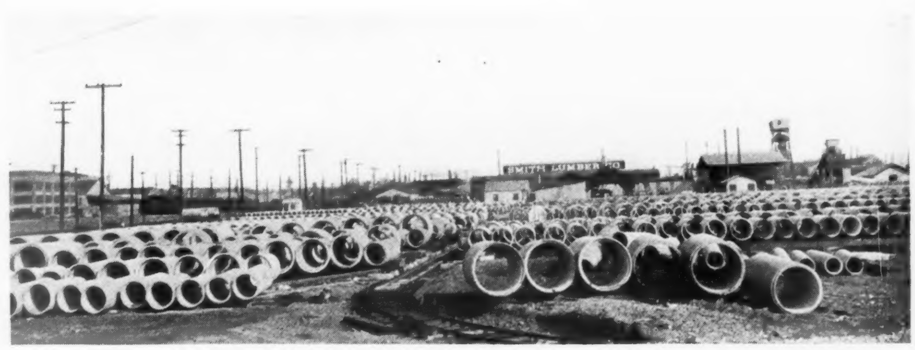
A 3-ton Shepard electric hoist spans the spinning machine and is used to handle the forms. The forms are stripped from the pipe and the pipe is removed to storage and kept moist by sprinkling for six days to insure complete hydration of all cement. Tests have shown the pipe to have a strength



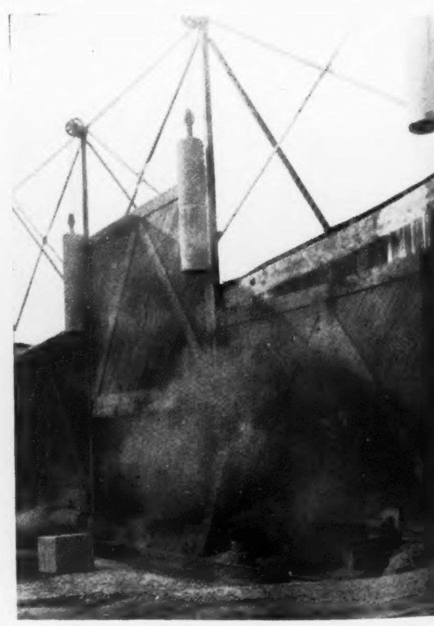
Making the pipe. The two at the right are being rotated while one is being filled. The two at the left are shown with reinforcing cages in place ready to receive the concrete

equivalent to that acquired in 10 days of ordinary curing when removed from the steam rooms. Steam for curing is supplied by two fire tube boilers, one 10 ft. by 36 in., and the other 7 ft. 6 in. by 60 in. dia. Oil is used for fuel with rotary oil burners.

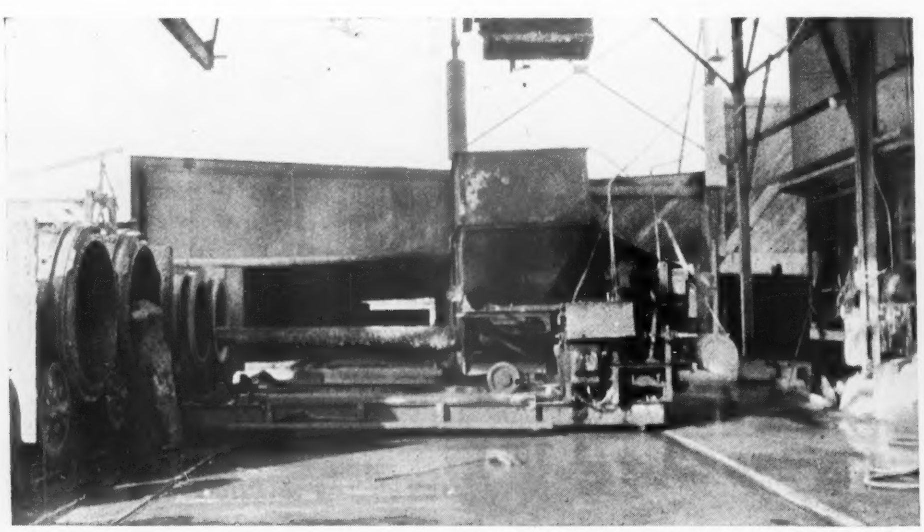
The outside storage space covers an area of about 10 acres, and transportation to and from the steam curing kilns to the storage yard is by an industrial track and gasoline locomotive. The pipe curing in the yard rest on concrete foundations.



A portion of the 10-acre storage yard at Oakland's newest concrete pipe plant



Three steam curing kilns are used followed by open storage



Form filling screw conveyor about to enter the revolving form where pipe is shaped

Pros. C. P. OB

The finished product loaded for shipment from the American Concrete Pipe Co., Oakland, Calif.

After the forms have been removed from the pipe they are reassembled in the yard by means of overhead carriers supplemented by Cyclone and Peerless chain blocks.

The cages for reinforcing are made on a duplex cage machine designed and constructed by the company. The winding is such that uniform tension is maintained at all times. Tying of the wire to the cage is done by hand.

Personnel

The local executive offices of the company are located at 41 Sutter street, San Francisco, Calif. The main offices of the company are in the Arcade building, 615 Broadway, Los Angeles, Calif. William A. Johnson is president; Ernest F. Brent, executive vice-president; H. H. Jenkins, vice-president; B. J. Primmer, vice-president; J. M. MacAdam, secretary; W. L. Jencks, treasurer. A. B. Smith is division manager for the Bay territory. France Geary is superintendent of the plant and W. L. Frazier is assistant superintendent.

Old Silica Quarry Converted to a Source of Pleasure and Profit

NEAR the present operation of the Standard Silica Co., Ottawa, Ill., is the abandoned quarry which has been turned into a reservoir and an unusual source of profit by F. D. Chadwick, manager of the Standard company. Although the rock was of excellent quality, underground springs were struck in quarrying which made further operation impossible. The quarry hole was considered a menace by the city authorities and they made the company fence it.

There was always the possibility of a damaging law suit in case anybody should accidentally fall in and drown. Then Mr. Chadwick got his idea of turning the property into a swimming beach. There was plenty of good sand and plenty of clean, cool water. He offered to lease it to the city for $1 a year, merely to get rid of the damage obligations, but the city officials could not see it. So at a cost of about $2000 for breaking down one of the steep faces to make a fill for a beach and for the usual health accessories such as life ropes, chutes for children and diving boards, Mr. Chadwick converted the old quarry into what is now known as Blackhawk Beach and patronized from miles around. During the summer there are life guards and instructors. With a small charge he has made the proposition pay more than its way and at the same time has made a swimming beach which is most unusual. The swimming hole covers about 14¾ acres, the depth being 110 ft. in places. Over 500,000 gallons of water are pumped to and from the hole each day.

How one silica sand producer solved the problem of what to do with an abandoned pit

Swimming pool formed in the old silica quarry of the Standard Silica Co. at Ottawa, Ill.

Canadian Reports of Interest to Rock Products Producers

THE Canadian Department of Mines at Ottawa has published circular No. 710 giving four papers, the first of which is a preliminary report on the limestones of northern and western Ontario and of the Prairie Provinces. This paper was by M. F. Goudge.

Paper No. 2, by L. H. Cole, relates to the potash salts in the Maritime Provinces of Canada, and paper No. 3, by S. C. Ells, is a report on the core drilling of bituminous sands in northern Alberta. The concluding report by C. H. Freeman is one dealing with the molding sands in eastern Canada.

Crusher Lubrication Booklet

THE VACUUM OIL CO. has published an illustrated pamphlet on the lubrication of crushers of all types. The descriptive matter includes illustrations in colors that clearly bring out the surfaces that need lubrication and the means for supplying that need. Lubrication of gyratory crushers of the various manufacturers is discussed as well as lubrication of many types of jaw crushers and hammer mills.

Recent Contract Prices

THE BIBB COUNTY board of Macon, Ga., commissioners, in special session recently, let a contract for the purchase of 15,000 bbl. of cement, part of which, it was said, will be used in the paving of the Miller Field road. The contract involved $32,550, the cement being purchased for $2.17 per bbl. It was divided among eight bidders.—*Macon* (Ga.) *Telegraph.*

The Rock Products Market

Wholesale Prices of Sand and Gravel

Prices given are per ton, F.O.B., producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
EASTERN:						
Asbury Park, N. J.		.65	1.25	1.25	1.15	1.15
Attica and Franklinville, N. Y.	.75	.75	.75	.75	.75	.75
Boston, Mass.‡	1.25	1.15	1.75		1.75	1.75
Buffalo, N. Y.	1.00	1.05	1.05	1.05	1.05	1.05
Erie, Penn.	.70	.95	1.40			
Machias Junction, N. Y.	.65	.65	.65		.65	.65
Milton, N. H.			1.75		1.25	1.00
Montoursville, Penn.	1.00	.75	.75	.60	.50	.50
Northern New Jersey	.30- .50	.30- .50	.90-1.25		.90-1.25	
South Portland, Me.		1.00	2.25	2.00	2.00	2.00
Georgetown, D. C.	.55	.55	1.00	1.00	1.00	1.00
CENTRAL:						
Algonquin, Ill.	.60	.30	.30	.40	.40	.40
Appleton, Minn.		.50	1.25		1.50	
Attica, Ind.	All sizes .75-.85					
Barton, Wis.		.40	.50	.60	.60	.60
Cincinnati, Ohio	.55	.55	.80	.80	.80	.80
Crystal Lake, Ill.	.30	.15	.25	.30	.30	.40
Des Moines, Iowa	.40- .60	.60- .80	1.50-1.70	1.50-1.70	1.50-1.70	1.50-1.70
Eau Claire, Wis.		.40	.55	.85	.85	
Elkhart Lake and Glenbeulah, Wis.	.50	.30	.50	.60	.50	.50
Grand Rapids, Mich.		.50		.80	.80	.70
Hamilton, Ohio	.65- .75	65.- .75	.65- .75	.65- .75	.65- .75	.65- .75
Hersey, Mich.		.50		.50	.70	.70
Humboldt, Iowa	.40- .50	.40- .50	1.10-1.30	1.10-1.30	1.10-1.30	1.10-1.30
Indianapolis, Ind.	.50.- .60	.25- .60	.40- .60	.45- .75	.45- .75	.45- .75
Kalamazoo, Mich.		.50	.50	.60	.65	.75
Kansas City, Mo.	.70	.70		.80		
Mankato, Minn.	.55	.45	1.25	1.25	1.25	
Mason City, Iowa	.50	.50	.85	1.25	1.25	1.25
Milwaukee, Wis.		.86	.86	.96	.96	.96
Minneapolis, Minn.	.35	.35	1.25	1.35	1.35	1.25
St. Paul, Minn. (e)	.35	.35	1.25	1.25	1.25	1.25
Terre Haute, Ind.	.75	.60	.75	.75	.75	.75
Urbana, Ohio	.65	.55	.65	.65	.65	.65
Waukesha, Wis.		.45	.60	.60	.65	.65
Winona, Minn.	.40	.40	.50	1.10	1.00	1.00
SOUTHERN:						
Brewster, Fla.	.50					
Charleston, W. Va.	.70	1.25	1.25			
Eustis, Fla.		.40- .50				
Fort Worth, Texas	.75	.75	1.00	1.00	1.00	1.00
Knoxville, Tenn.	.80	1.00	1.50	1.20	1.20	1.20
Roseland, La.	.20	.20	.70	.70	.60	
WESTERN:						
Los Angeles, Calif.	.10- .40	.10- .40	.20- .90	.50- .90	.50- .90	.50- .90
Oregon City, Ore.	Sand for concrete, 1.00-1.50 per cu. yd. at plant					
Phoenix, Ariz.	1.25*	1.15*	1.50*	1.15*	1.15*	1.00*
Pueblo, Colo.	.80	.60		1.20	1.20	1.15
Seattle, Wash.	1.00*	1.00*	1.00*	1.00*	1.00*	1.25*

*Cu. yd. ‡Delivered on job by truck. (e) Prices f.o.b. N. P. Ry.

Core and Foundry Sands

Silica sand quoted washed, dried, screened unless otherwise stated; per ton f.o.b. plant.

City or shipping point	Molding, fine	Molding, coarse	Molding brass	Core	Furnace lining	Sand blast	Stone sawing
Albany, N. Y.	2.00	2.00	2.00			4.00	
Cedarville, N. J.	Washed, 1.75 net ton; dried and washed, 2.25 net ton						
Cheshire, Mass.	Sand for soap, 7.00-8.00					6.00-8.00	
Columbus, Ohio	1.50	1.50	1.35	.90		3.50-4.50	
Eau Claire, Wis.						2.00-3.00	
Elco, Ill.	Soft amorphous silica, 92%-99% thru 325 mesh, 18.00-40.00 per ton						
Kasota, Minn.							1.00
Montoursville, Penn.				1.35-1.50			
New Lexington, Ohio	2.00	1.25					
Ohlton, Ohio	1.75*	1.75*		2.00*	1.75*	1.75*	
Ottawa, Ill.	1.25-3.25	2.25-3.50	1.25-3.25	1.25-3.25	1.25	3.50	3.50
Red Wing, Minn. (a)					1.50	3.00	1.50
San Francisco, Calif.	3.50†	5.00†	3.50†	2.50-3.50†	5.00†	3.50-5.00†	
Utica and Ottawa, Ill.	.50- .65	.75- .90	.75-1.00	.75-1.00	.75-1.00		1.00

†Fresh water washed, steam dried. *Damp. (a) Filter sand, 3.00.

Miscellaneous Sands

City or shipping point	Roofing sand	Traction
Beach City, Ohio		1.50
Eau Claire, Wis.	4.30	.60-1.00
Montoursville, Penn.		1.00
Ohlton, Ohio	1.75	1.75
Ottawa, Ill.	1.25-3.25	1.25
Red Wing, Minn.		1.00
San Francisco, Calif.	3.50	3.50
Silica, Va.		1.75

Glass Sand

(Silica sand is quoted washed, dried and screened)

Cheshire, Mass., in carload lots	5.00-7.00
Klondike, Mo.	2.00
Ohlton, Ohio	2.50
Ottawa, Ill.	1.25
Red Wing, Minn.	1.50
San Francisco, Calif.	4.00-5.00
Silica and Mendota, Va.	2.50-3.00

Bank Run Sand and Gravel

Appleton, Minn.†	.55
Algonquin, Ill.¶ (½-in. and less)	.30
Brewster, Fla. (sand, ¼-in. and less)	.40- .50
Burnside, Conn. (sand, ¼-in. and less)	.75*
Chicago, Ill., and Grand Haven, Mich.†	.92-1.20
Crystal Lake, Ill.¶ (½-in. and less)	.25
Des Moines, Ia. (sand and gravel mix)	.60-1.05
Fort Worth, Tex.¶ (2-in. and less)	.65
Gainesville, Tex.¶ (1½-in. and less)	.55
Gary and Miller, Ind.†	1.15-1.40a
Grand Rapids, Mich.¶ (1-in. and less.)	.55
Hamilton, Ohio¶ (1½-in. and less)	.50-1.00
Hersey, Mich.¶ (1-in. and less)	.50
Kalamazoo, Mich.	1.85b
Mankato, Minn.†	.70
Oregon City, Ore.—River run	1.00-1.50
Pueblo, Colo.—†River run sand	.50
Winona, Minn.†	.60
York, Penn.—Sand, 1/10-in. down	1.10

*Cubic yard. †Fine sand, 1/-10-in. down. (a) Cu. yd., delivered Chicago. (b) 1⅓ cu. yd. ¶Gravel.

***ROCK PRODUCTS** solicits volunteers to furnish accurate price quotations.*

Portland Cement

	F.o.b. city named Per Bag	Per Bbl.	High Early Strength
Albuquerque, N. M.	.82½	3.30	4.30¶
Atlanta, Ga.		2.19†	3.49¶
Baltimore, Md.		2.26*	3.56¶
Berkeley, Calif.		2.14	
Birmingham, Ala		1.85†	3.15¶
Boston, Mass.	.47	1.88†	3.27¶
Buffalo, N. Y.	.51¼	2.05†	3.35¶
Butte, Mont.	.90¼	3.61	
Cedar Rapids, Ia.		2.23*	
Centerville, Calif.		2.14	
Charleston, S. C.		a2.29†	3.26¶
Cheyenne, Wyo.	.61½	2.46	
Chicago, Ill.		1.95*	3.25¶
Cincinnati, Ohio		2.14*	3.44¶
Cleveland, Ohio		2.04*	3.34¶
Columbus, Ohio		2.12†	3.47¶
Dallas, Texas		†1.90-2.20	3.49¶
Davenport, Iowa		2.14*	
Dayton, Ohio		2.14†	3.44¶
Denver, Colo.	.66¼	2.65	
Des Moines, Iowa	.48½	1.94	
Detroit, Mich.		1.95*	3.25¶
Duluth, Minn.		2.04*	
Fresno, Calif.		2.33	
Houston, Texas		†2.00-2.30	3.73¶
Indianapolis, Ind.	.54¾	1.99*	3.29¶
Jackson, Miss.		2.29†	3.59¶
Jacksonville, Fla.		b2.34†	3.26¶
Jersey City, N. J.		2.13†	3.43¶
Kansas City, Mo.	.50½	2.02	3.22¶
Los Angeles, Calif.	.43	1.72	
Louisville, Ky.	.55½	2.12-2.15†	3.42¶
Memphis, Tenn.		2.29†	3.59¶
Merced, Calif.		2.01	
Milwaukee, Wis.		2.10*	3.40¶
Minneapolis, Minn.		2.27*	
Montreal, Que.		1.60‖	
New Orleans, La.	.43	1.92†	3.22¶
New York, N. Y.	.50¾	2.03*	3.33¶
Norfolk, Va.		1.97†	3.27¶
Oklahoma City, Okla.	.61½	2.46	3.66¶
Omaha, Neb.	.59	2.36	3.56¶
Peoria, Ill.		2.12*	3.32¶
Pittsburgh, Penn.		1.95*	3.25¶
Philadelphia, Penn.		2.15*	3.45¶
Phoenix, Ariz.		3.51	
Portland, Ore.		2.50‡	
Reno, Nev.		2.76‡	
Richmond, Va.		2.32†	3.62¶
Sacramento, Calif.		2.25	
Salt Lake City, Utah	.70¼	2.81	
San Antonio, Texas			3.42¶
San Francisco, Calif.		2.24‡	
Santa Cruz, Calif.		2.10	
Savannah, Ga.		a2.29†	3.16¶
St. Louis, Mo.	.48¾	1.95†	3.25¶
St. Paul, Minn.		2.27*	
Seattle, Wash.		1.75-1.90	†2.50c
Tampa, Fla.		2.00†	3.41¶
Toledo, Ohio		2.20*	3.50¶
Topeka, Kan.	.55¼	2.21	3.41¶
Tulsa, Okla.	.58¼	2.33	3.53¶
Wheeling, W. Va.		2.02†	3.32¶
Winston-Salem, N.C.		2.44†	3.54¶
Mill prices f.o.b. in carload lots, without bags, to contractors.			
Albany, N. Y.		2.15	
Bellingham, Wash.		2.25	
Bonner Springs, Kan.		1.85	
Buffington, Ind.		1.70	
Chattanooga, Tenn.		2.05	
Concrete, Wash.		2.65	
Davenport, Calif.		2.05	
Hannibal, Mo.		1.80	
Hudson, N. Y.		1.85	
Independence, Kan.		1.85	
Leeds, Ala.		1.70	
Limedale, Ind.		1.70	
Lime & Oswego, Ore.		2.50	
Nazareth, Penn.		2.15	
Northampton, Penn.		1.75	
Richard City, Tenn.		2.05	
Steelton, Minn.		1.85	
Toledo, Ohio		2.20	
Universal, Penn.		1.70	
Waco, Tex.		1.85	

NOTE: Unless otherwise noted, prices quoted are net prices, without charge for bags. Add 40c per bbl. for bags. *Includes dealer and cash discounts. †Includes 10c cash discount. ‡Subject to 2% cash discount. (a) 44c refund for paid freight bill. (b) 38c bbl. refund for paid freight bill. ¶"Incor" Perfected, prices per bbl. packed in paper sacks, subject to 10c discount 15 days. ‖Includes sales tax. (c) Quick-hardening "Velo."

Wholesale Prices of Crushed Stone

Prices given are per ton, F.O.B., producing plant or nearest shipping point

Crushed Limestone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:						
Buffalo, N. Y.	1.30	1.30	1.30	1.30	1.30	1.30
Chazy, N. Y.	.75	1.60	1.60	1.30	1.30	1.30
Farmington, Conn.	....	1.30	1.10	1.00	1.00	....
Ft. Spring, W. Va.	.35	1.35	1.35	1.25	1.15	1.00
Jamesville, N. Y.	1.00	1.00	1.00	1.00	1.00	1.00
Oriskany Falls, N. Y.	.50–1.00	1.00–1.35	1.00–1.35	1.00–1.35	1.00–1.35	1.00–3.00
Prospect Junction, N. Y.	.50– .80	....	1.00–1.15	1.00–1.10	1.00–1.10	....
Rochester, N. Y.—Dolomite	1.50	1.50	1.50	1.50	1.50	1.50
Hillsville, Penn.	.85	1.35	1.35	1.35	1.35	1.35
Shaw's Junction, Penn. (e)	.85	1.20–1.35	1.20–1.35	1.20–1.35	1.40	1.30–1.35
Western New York	.85	1.25	1.25	1.25	1.25	1.25
CENTRAL:						
Alton, Ill. (b)	2.00	....	2.00	....	....	....
Afton, Mich.	....	....	....	.25	.50– .75	1.50
Cypress, Ill.	.90	.90	.90	.90	1.00	1.15
Davenport, Iowa	1.20	1.50	1.50	1.30	1.30	1.30
Dubuque, Iowa	1.00	1.00	1.00	1.10	1.10	1.10
Dundas, Ont.	.50	.80	.80	.70	.70	....
Stolle and Falling Springs, Ill.	1.05–1.70	.95–1.70	1.15–1.70	1.05–1.70	1.05–1.70	....
Greencastle, Ind.	1.25	1.10	1.10	1.00	1.00	1.00
Lannon, Wis.	.80	1.00	1.00	.90	.90	.90
McCook, Ill.	.80	1.00	1.00	1.00	1.00	1.00
Montreal, Canada	.75–1.00	1.65–1.85	1.45	1.15	1.05	.95
Sheboygan, Wis.	1.00	1.00	1.00	1.00	1.00	1.00
Stone City, Iowa	.75	....	1.10	1.00	1.00	1.00h
Toledo, Ohio	1.60	1.70	....	1.60	....	1.60
Toronto, Canada	2.50	3.00	2.50	2.50	2.50	2.50
Waukesha, Wis.	....	.90	.90	.90	.90	.90
Wisconsin points	.50	....	1.00	.90	.90	....
SOUTHERN:						
Cartersville, Ga.	1.00	1.50	1.50	1.25	1.00	1.00
Chico and Bridgeport, Texas	1.00	1.15	1.20	1.15	1.00	1.00
Cutler, Fla.	.50r	1.75r	1.75r	1.75r	1.75r	1.50r
El Paso, Texas (v)	.50	1.25	1.25	1.00	1.00	1.00
Graystone, Ala.		Crusher run stone 1.00 per net ton				
Olive Hill, Ky.	.50–1.00	1.00	1.00	.90	.90	.90
Rocky Point, Va.	.50– .75	1.40–1.60	1.30–1.40	1.15–1.40	1.10–1.20	1.00–1.05
WESTERN:						
Atchison, Kan.	.50	1.80	1.80	1.80	1.80	1.70
Blue Springs and Wymore, Neb. (t)	.25	.25	1.45	1.35c	1.25d	1.20
Cape Girardeau, Mo.	1.00	1.25	1.00	1.00	1.00	....
Richmond, Calif.	.75	....	1.00	1.00	1.00	....
Rock Hill, St. Louis Co., Mo.	1.30–1.40	1.30–1.40	1.10–1.40	1.30–1.40	1.30–1.40	1.30–1.40
Stringtown, Okla.	1.00	1.15	1.20	1.15	1.00	1.00

Crushed Trap Rock

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Birdsboro, Penn. (q)	1.20	1.60	1.45	1.35	....	1.30
Branford, Conn.	.80	1.70	1.45	1.20	1.05	....
Farmington, Conn.	1.00	1.30	1.30	1.00	1.00	....
Duluth, Minn.	1.00	2.25	1.75	1.65	1.35	1.25
Eastern Maryland	1.00	1.60	1.60	1.50	1.35	1.35
Eastern Massachusetts	.85	1.75	1.75	1.25	1.25	1.25
Eastern New York	.75	1.25	1.25	1.25	1.25	1.25
Eastern Pennsylvania	1.10	1.70	1.60	1.50	1.35	1.35
Knippa, Texas	1.15	1.25	1.50	1.30	1.15	1.10
New Britain, Plainville, Rocky Hill, Wallingford, Meriden, Mt. Carmel, Conn.	.80	1.70	1.45	1.20	1.05	....
Northern New Jersey	1.35	2.10	1.90	1.50	1.50	....
Richmond, Calif.	.50	....	1.00	1.00	1.00	....
Toronto, Canada	4.70	5.80	4.05	4.05	4.05	....
Westfield, Mass.	.60	1.50	1.35	1.20	1.10	....

Miscellaneous Crushed Stone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Cayce, S. C.—Granite	....	....	1.60	1.60	1.50	....
Chicago, Ill.—Granite	2.00	1.70	....	1.50	1.50	....
Eastern Pennsylvania—Sandstone	1.35	1.70	1.65	1.40	1.40	1.40
Eastern Pennsylvania—Quartzite	1.20	1.35	1.25	1.20	1.20	1.20
Lithonia, Ga.—Granite	.50	1.50	1.40	1.25	1.15	....
Lohrville, Wis.—Granite	1.80	1.60	....	1.50	1.50	....
Middlebrook, Mo.—Granite	3.00–3.50	....	2.00–2.25	2.00–2.25	....	1.25–3.00
Toccoa, Ga.—Granite	.50	1.35	1.35	1.25	1.25	1.20

(b) Wagonloads. (c) 1 in., 1.40. (d) 2-in., 1.30. (e) Price net after 10c discount deducted. (h) Rip rap. (n) Ballast, R. R., .90; run of crusher, 1.00. (q) Crusher run, 1.40; ¼-in. granlithic finish, 3.00. (r) Cu. yd. (t) Rip rap, 1.20–1.40 per ton. (v) Roofing stone, 1.50 per ton.

Crushed Slag

City or shipping point	Roofing	¼ in. down	½ in. and less	¾ in. and less	1½ in. and less	2½ in. and less	3 in. and larger
EASTERN:							
Allentown, Penn.	1.00–1.50	.40– .60	.80–1.00	.50– .80	.50– .80	.60– .80	.80
Bethlehem, Penn.	1.25–1.75	.50– .60	1.00–1.25	.60– .80	.70– .80	.70– .90	.90
Buffalo, N. Y., Erie and Du Bois, Penn.	2.25	1.25	1.25	1.35	1.25	1.25	1.25
Hokendauqua, Penn.	1.50	.70	1.00	1.15	1.15	1.15	1.15
Reading, Penn.	2.00	1.00	....	1.00	....	....	....
Swedeland, Penn.	1.50–2.50	.60–1.10	1.00–1.25	.90–1.25	.90–1.25	1.25	1.25
Western Pennsylvania	2.00	1.25	1.25	1.25	1.25	1.25	1.25
CENTRAL:							
Ironton, Ohio	....	1.30*	1.80*	1.45*	1.45*	1.45*	1.45*
Jackson, Ohio	....	.65*	1.80*	1.30*	1.30*	1.30*	1.30*
Toledo, Ohio	1.50	1.10	1.35	1.35	1.35	1.35	1.35
SOUTHERN:							
Ashland, Ky.	....	1.05*	1.80*	1.45*	1.45*	1.45*	1.45*
Ensley and Alabama City, Ala.	2.05	.55	1.25	1.15	.90	.90	.80
Longdale, Va.	2.50	.75	1.25	1.25	1.25	1.15	1.05
Woodward, Ala.†	2.05	.55*	....	1.15*	.90*	.90*	....

5c per ton discount on terms. †1¼ in. to ¼ in., 1.05; ⅝ in. to 10 mesh, 1.25*; ⅝ in. to 0 in., 90*; ¼ in. to 10 mesh, .80*.

Agricultural Limestone

(Pulverized)

Alton, Ill.—Analysis, 99% $CaCO_3$; 0.3% $MgCO_3$, 90% thru 100 mesh	4.50
Cape Girardeau, Mo.—Analysis, $CaCO_3$, 94½%; $MgCO_3$, 3½%; 90% thru 50 mesh	1.50
Cartersville, Ga.	2.00
Davenport, Iowa — Analysis, 92-98% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 20 mesh, 50% thru 200 mesh; sacks, per ton	6.00
Gibsonburg, Ohio—Bulk, 2.25; in bags	3.70
Hillsville, Penn.	2.10–4.50
Jamesville, N. Y.—Bulk, 3.50; in 80-lb. bags	4.75
Joliet, Ill.—Analysis, 50% $CaCO_3$; 44% $MgCO_3$; 90% thru 200 mesh	3.50
Knoxville, Tenn.—Analysis, 52% $CaCO_3$; 36% $MgCO_3$; 80% thru 100 mesh, bags, 3.75; bulk	2.50
Marion, Va.—Analysis, 90% $CaCO_3$, 2% $MgCO_3$; per ton	2.00
Middlebury, Vt.—Analysis, 99.05% $CaCO_3$; 90% thru 50 mesh	4.25
Olive Hill, Ky., per ton	1.00
West Rutland, Vt. — Analysis, 96.5% $CaCO_3$; 1% $MgCO_3$, in 100-lb. burlap bags, per ton	4.50

Agricultural Limestone

(Crushed)

Bedford, Ind.—Analysis, 98% $CaCO_3$; 1% $MgCO_3$; 90% thru 10 mesh; 30% thru 100 mesh	1.50
Cartersville, Ga.—50% thru 50 mesh	1.50
Chico and Bridgeport, Texas—Analysis, 95% $CaCO_3$; 1.3% $MgCO_3$; 50% thru 50 mesh	1.00
Colton, Calif.—Analysis, 95-97% $CaCO_3$; 1.31% $MgCO_3$, all thru 14 mesh down to powder	3.50
Cypress, Ill.—Analysis, 96% $CaCO_3$; 90% thru 100 mesh, 1.25; 50% thru 100 mesh, 1.25; 90% thru 50 mesh, 1.25; 50% thru 50 mesh, 1.15; 90% thru 4 mesh, 1.25, and 50% thru 4 mesh	1.15
Davenport, Iowa — Analysis, 92-98% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 4 mesh, 50% thru 20 mesh; bulk, per ton	1.20
Dubuque, Ia.—Analysis, 64.04% $CaCO_3$; 29.54% $MgCO_3$; 50% thru 100 mesh	1.00
Dundas, Ont.—Per ton	1.00
Fort Spring, W. Va.—Analysis, 90% $CaCO_3$; 3% $MgCO_3$; 50% thru 100 mesh; bulk, per ton	1.15–1.50
Gibsonburg, Ohio—90% thru 10 mesh	1.00–1.50
Hillsville, Penn.—90% thru 100 mesh, 50% thru 100 mesh and 90% thru 50 mesh	1.00–4.50
Lannon, Wis. — Analysis, 54% $CaCO_3$ 44% $MgCO_3$; 99% thru 10 mesh; 46% thru 60 mesh	2.00
Screenings (¼ in. to dust)	1.00
Marblehead, Ohio—90% thru 100 mesh	3.00
90% thru 50 mesh	2.00
90% thru 4 mesh	1.00
McCook and Gary, Ill.—Analysis, 60% $CaCO_3$, 40% $MgCO_3$; 90% thru 4 mesh	.80
Osborne, Penn.—50% thru 100 mesh	3.50–5.00
Rocky Point, Va.—50% thru 200 mesh, bulk, in carloads, 2.00; 100-lb. paper bags, 3.25; 200-lb. burlap bags	3.50
Stolle and Falling Springs, Ill.—Analysis, 89.9% $CaCO_3$, 3.8% $MgCO_3$; 90% thru 4 mesh	1.15–1.70
Stone City, Iowa — Analysis, 98% $CaCO_3$; 50% thru 50 mesh	.75
West Stockbridge, Mass.* — Analysis, 95% $CaCO_3$; 90% thru 100 mesh, bulk	3.50
100-lb. paper bags, 4.75; 100-lb., cloth	5.25
Waukesha, Wis.—90% thru 100 mesh, 4.00; 50% thru 100 mesh	2.10

*Less 25c cash 15 days.

Pulverized Limestone for Coal Operators

Davenport, Iowa—Analysis, 97% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 20 mesh, 50% thru 200 mesh; sacks, ton	6.00
Hillsville, Penn., sacks, 5.10; bulk	3.50
Joliet, Ill.—Analysis, 48% $CaCO_3$; 42% $MgCO_3$; 90% thru 200 mesh (bags extra)	3.50
Rocky Point, Va.—Analysis, 97% $CaCO_3$; 75% $MgCO_3$; 85% thru 200 mesh, bulk	2.25–3.50
Waukesha, Wis.—90% thru 100 mesh, bulk	4.00

Lime Products

(Carload prices per ton f.o.b. shipping point unless otherwise noted)

	Finishing hydrate	Masons' hydrate	Agricultural hydrate	Chemical hydrate	Ground burnt lime, Blk.	Ground burnt lime, Bags	Lump lime In bulk	Lump lime In bbl.
EASTERN:								
Berkeley, R. I.	....	....	11.40	....	....	17.50	....	20.65
Knickerbocker, Devault and Rambo, Penn.*	....	9.50b	9.50b	9.50b	8.00	9.50	8.50	....
Lime Ridge, Penn.	....	....	8.75	....	6.50	8.00[3]	5.00	....
CENTRAL:								
Afton, Mich.	....	....	....	....	....	10.00	6.50	....
Carey, Ohio	9.50	6.50	6.50	....	8.00	....	8.00	....
Cold Springs, Ohio	....	7.75	7.75	....	....	....	7.00	....
Gibsonburg, Ohio	10.50	....	....	....	7.00	9.00[9]	....	....
Little Rock, Ark.	....	14.40	....	14.40	....	....	11.90	....
Luckey, Ohio*	10.50	7.75	7.75	....	....	....	7.00	....
Marblehead, Gibsonburg, Marion, Sandusky, Tiffin and White Rock, Ohio	10.50	7.75	7.75	11.00	7.00	9.00	7.00	....
Milltown, Ind.	....	9.00	8.25	9.50	7.50	....	7.00	....
Scioto, Ohio	9.75–10.50	6.00– 7.50	6.00– 7.50	7.00– 7.50	....	....	6.00	....
Sheboygan, Wis.	....	10.50	10.50	....	....	....	9.50	9.50
Wisconsin points	....	11.50	....	....	....	....	9.50	....
Woodville, Ohio	10.50	7.75	7.75	11.50[24]	7.00	9.00[9]	7.00	11.50‖
SOUTHERN:								
Cartersville, Ga.	....	9.00	....	....	....	13.50	....	15.00
Graystone, Ala.*	12.50	9.00	....	12.50	....	....	7.50	....
Keystone, Ala.	17.00	9.00	....	7.00– 9.00	....	....	5.00a	14.85
Knoxville, Tenn.	20.00	9.00	9.00	7.50	7.50	....	7.50	27.00
Ocala, Fla.	....	10.50	....	....	....	....	....	....
Pine Hill, Ky.	....	9.00	8.00	9.00	....	....	....	12.50
WESTERN:								
Colton, Calif.	....	....	....	....	9.50[4]	....	....	....
Kirtland, N. M.	....	....	....	....	....	....	15.00	20.00
Los Angeles, Calif.	....	....	....	....	....	....	12.00	....
San Francisco, Calif.†	16.00	14.00	6.00–12.00	14.00–19.00	14.50[20]	....	11.00[19]	....
San Francisco, Calif.	19.00	14.00–17.00	12.50	14.00–19.00	14.50[20]	....	11.00[19]	....

[1]Also 6.00. [2]To 1.35. [3]In 100-lb. bags. [4]To 11.85 per ton, granular but not ground, ¾-in. screen down to 14 mesh. [9]In 80-lb. paper. [10]Per bbl. [11]In wood; in steel, 11.60. [17]Less credit for return of empties. [19]To 14.50. [20]Also 13.00. [24]Superfine, 92.25% thru 200 mesh. *Price to dealers. †Wood-burnt lime: finishing hydrate 20.00 per ton, pulv. lime 2.00 per iron drum. Oil-burnt pulv. lime, 13.00–14.50 per ton. ‡To 6.00. ¶To 13.50. (a) To 8.50. (b) In bags.

Wholesale Prices of Slate

Prices given are f.o.b. at producing point or nearest shipping point

Slate Flour

Pen Argyl, Penn.—Screened, 100% thru 200 mesh, 7.00 per ton in paper bags.

Slate Granules

Esmont, Va.—Blue, $7.50 per ton.

Granville, N. Y.—Red, green and black, $7.50 per ton.

Pen Argyl, Penn.—Blue-grey, 6.50 per ton in bulk, plus 10c per bag.

Roofing Slate

Prices per square—Standard thickness.

City or shipping point:	3/16-in.	¼-in.	⅜-in.	½-in.	¾-in.	1-in.
Arvonia, Va.—						
Buckingham oxford grey	13.88	17.22	24.99	29.44	34.44	45.55
Bangor, Penn.—No. 1 clear	10.00–14.00	20.00	25.00	29.00	40.00	50.00
No. 1 ribbon	9.00–10.25	16.00	20.00	25.00	35.00	46.00
Gen. Bangor No. 2 ribbon	6.75– 7.25	....	....	....	....	....
No. 1 Albion	7.25–10.50	16.00	23.00	27.00	37.00	46.00
Chapman Quarries, Penn.	7.75–11.25	13.00–15.00	19.00–22.00	23.00–28.00	27.00–30.00	32.00–35.00
Granville, N. Y.—						
Sea green, weathering	14.00	24.00	30.00	36.00	48.00	60.00
Semi-weathering, green & gray	15.40	24.00	30.00	36.00	48.00	60.00
Mottled purple & unfading gr'n	21.00	24.00	30.00	36.00	48.00	60.00
Red	27.50	33.50	40.00	47.50	62.50	77.50
Monson, Maine	19.80	24.00	....	....	....	....
Pen Argyl, Penn.*						
Graduated slate (blue)	....	16.00	23.00	27.00	37.00	46.00
Graduated slate (grey)	....	18.00	25.00	29.00	39.00	48.00
Color-tone	11.50–12.50; Vari-tone, 12.00–13.00; Cathedral gray, 14.00–15.00					
No. 1 clear (smooth text)	7.25–10.50; No. 1 clear (rough text), 8:25–9.50					
Albion-Bangor medium	8.00–9.00; No. 2 clear, 8.00–9.00; No. 1 ribbon, 8.00–8.50					
Slatedale and Slatington, Penn.—						
Genuine Franklin	11.25	22.00	26.00	30.00	40.00	50.00
Blue Mountain No. 1	10.50	22.00	26.00	30.00	40.00	50.00
Blue Mountain No. 1 clear	9.50	18.00	22.00	26.00	36.00	46.00
Blue Mountain No. 2 clear	8.00	18.00	22.00	26.00	36.00	46.00

(a) Prices are for standard preferred sizes (standard 3/16-in. slates), smaller sizes sell for lower prices.
(b) Prices other than 3/16-in. thickness include nail holes.
(c) Prices for punching nail holes, in standard thickness slates, vary from 50c to $1.25 per square.
*Unfading grey, 14.00–15.00; 10% disc. to roofer; 10%–8⅓% to wholesaler.

Talc

Prices given are per ton f.o.b. (in carload lots only), producing plant, or nearest shipping point.

Chatsworth, Ga.:	
Crude talc, per ton	5.00
Ground talc (20-50 mesh), bags	6.50
Ground talc (150-200 mesh), bags	9.00
Pencils and steel crayons, gross	1.50– 2.00
Chester, Vt.—Finely ground talc (carloads), Grade A—99-99¾% thru 200 mesh, 8.00–8.50; Grade B, 97-98% thru 200 mesh	7.50– 8.00
1.00 per ton extra for 50-lb. paper bags; 166⅔-lb. burlap bags, 15c each; 200-lb. burlap bags, 18c each. Credit for return of bags. Terms 1%, 10 days.	
Clifton, Va.:	
Crude talc, per ton	4.00
Ground talc (150-200 mesh), in bags	12.00
Conowingo, Md.:	
Crude talc, bulk	4.00
Ground talc (150-200 mesh), in bags	14.00
Cubes, blanks, per lb.	.10
Emeryville, N. Y.:	
Ground Talc (200 mesh), bags	13.75
Ground talc (325 mesh), bags	14.75
Hailesboro, N. Y.:	
Ground talc (300-350 mesh) in 200-lb. bags	15.50–20.00
Henry, Va:.	
Crude (mine run), bulk	3.50– 4.25
Ground talc (150-200 mesh), bags	6.25– 9.75
Joliet, Ill.:	
Ground talc (200 mesh) in bags:	
California white	30.00
Southern white	20.00
Illinois talc	10.00
Los Angeles, Calif.:	
Ground talc (150-200 mesh), in bags	15.00–25.00
Natural Bridge, N. Y.:	
Ground talc (325 mesh), bags	10.00–15.00

Rock Phosphate

Prices given are per ton (2240-lb.) f.o.b. producing plant or nearest shipping point.

Lump Rock

Gordonsburg, Tenn.—B.P.L. 65-70%	3.50–4.00
Mt. Pleasant, Tenn.—B.P.L. 76-78%	6.75

Ground Rock

(2000 lb.)

Gordonsburg, Tenn.—B.P.L. 65–70%	3.75– 4.25
Mt. Pleasant, Tenn. — Lime phosphate: B.P.L. 73.25%	11.80
Mt. Pleasant, Tenn.—B.P.L., 72%	5.00– 5.50

Florida Phosphate

(Raw Land Pebble)

(Per Ton)

Mulberry, Fla.—Gross ton, f.o.b. mines	
68/66% B.P.L.	3.15
70% minimum B.P.L.	3.75
72% minimum B.P.L.	4.25
75/74% B.P.L.	5.25
77/76% B.P.L.	6.25

Mica

Prices given are net, f.o.b. plant or nearest shipping point.

Pringle, S. D.—Mine run, per ton	100.00–125.00
Punch mica, per lb.	.06
Scrap, per ton, carloads	20.00
Rumney Depot, Bristol and Cardigan, N. H.—Per ton:	
Punch mica, per ton	150.00–240.00
Mine scrap	22.50
Mine run	325.00
Clean shop scrap	25.00
Roofing mica	37.50
Trimmed mica, per ton, 20 mesh, 37.50; 40 mesh, 40.00; 60 mesh, 40.00; 100 mesh, 45.00; 200 mesh	60.00
Spruce Pine, N. C.—Mine scrap, per ton	20.00
Trenton, N. J.—Mine scrap, per ton, f.o.b. mines	20.00

Gypsum Products— CARLOAD PRICES PER TON AND PER M SQUARE FEET, F.O.B. MILL

	Crushed Rock	Ground Gypsum	Agricultural Gypsum	Stucco Calcined Gypsum	Cement and Gaging Plaster	Wood Fiber	Gaging White	Plaster Sanded	Cement Keene's	Finish Trowel	Plaster Board ¼x32x36". Per M Sq. Ft.	Plaster Board ⅜x32x36". Per M Sq. Ft.	Wallboard, ⅜x32 or 48" Lengths 6'-10'. Per M Sq. Ft.
Acme, Tex.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Blue Rapids, Kan.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Centerville, Iowa	....	....	6.00	7.00	....	7.50	8.50	10.50a	....	....	....	....	....
East St. Louis, Ill.—Special Gypsum Products—Partition section, 4 in. thick, 12 in. wide, and up to 10 ft. 3 in. long, 12c per ft., 21.00 per ton; outside wall section and interior bearing wall section, 6 in. wide, 6 in. thick, and up to 10 ft. 3 in. long, 25c per ft., 30.00 per ton, floor section, 7 in. thick, 16 in. wide, and up to 13 ft. 6 in. long, 17c per ft., 23.00 per ton.													
Fort Dodge, Iowa	2.50	6.00	6.00	7.00	9.00	9.00	11.50	8.00	16.00	20.00	15.00	....	25.00
Grand Rapids, Mich. (h)	....	....	7.00	9.00	9.00d	9.50d	19.50	8.00d	26.00	20.00d	....	....	25.00
Los Angeles, Calif. (b)	....	7.00–9.00	7.00–9.00	7.50–9.00	8.00–10.00	....	8.00–10.00	....	30.00c	....	....	....	....
Medicine Lodge, Kan.	1.40	....	....	....	....	....	11.50d	....	16.00d	....	....	....	....
Oakfield, N. Y.	3.00	....	....	6.00	9.00d	9.00d	....	6.00	....	....	....	....	....
Port Clinton, Ohio	3.00	4.00	6.00	9.00	9.00	9.00	20.00	8.00	25.50	20.00i	....	15.00	25.00
Portland, Colo.	....	7.00	7.00	9.00	9.00	9.50	9.00	....	27.50	....	22.50	27.50	....
Providence, R. I. (x)	....	....	....	12.00–13.00e	....	....	....	....	....	....	....	....	....
Seattle, Wash. (z)	6.00	9.00	9.00	13.00	....	....	14.00	....	....	....	....	....	....
Winnipeg, Man.	5.00	5.00	7.00	13.00	14.00	14.00	....	....	....	....	20.00	25.00g	33.00f

NOTE—Returnable bags, 10c each; paper bags, 1.00 per ton extra (not returnable). (a) White molding. (b) Plasterboard, ¼x32x36-in., 14c-17c per sq. ft.; ⅜x32x36-in., 15c-18c per sq. ft. (c) To 40.00. (d) Includes paper bags. (e) Includes jute sacks. (f) "Gyproc," ⅜x48-in. by 5 and 10 ft. long. (g) ⅜x48 by 3 to 4 ft. long. (h) Gypsum lath, per M sq. ft., 15.00. (i) To 26.00. (x) "Fabricaste" gypsum blocks, 2- and 3-in., f.o.b. motor trucks at plant, 7¼c-8¼c. Block setting plaster, per ton, in jute sacks, 12.00. (y) Jute sacks, 18.00; paper sacks, 16.00. (z) Gypsum partition tile, 3-in., 9c per sq. ft.; 4-in., 11c per sq. ft.

Special Aggregates

Prices are per ton f.o.b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco-chips
Brandon, Vt.—English pink, cream and coral pink	¶12.50–‖14.50	¶12.50–‖14.50
Cranberry Creek, N. Y.—Bio-Spar, per ton in bags in carload lots, 9.00; less than carload lots, 12.00 per ton in bags, bulk, per ton	......	7.50
Crown Point, N. Y.—Mica Spar	......	¶9.00–¶12.00
Davenport, Iowa — White limestone, in bags, per ton	‖6.00	‖6.00
Harrisonburg, Va.	12.50–14.50	......
Middlebrook, Mo.—Red	......	20.00–25.00
Middlebury, Vt.—Middlebury white	......	¶9.00–‖10.00
Middlebury and Brandon, Vt.—Caststone, per ton, including bags	......	c5.50
Phillipsburg, N. J.	......	15.00–18.00
Randville, Mich.—Crystalite white marble, bulk	4.00	4.00– 7.00
Tuckahoe, N. Y.—Tuckahoe white	7.00	......
Warren, N. H. (d)	......	¶8.00– 8.50
Whitestone, Ga.	......	10.00

¶C.L. ‖L.C.L. (a) Including bags. (b) In burlap bags, 2.00 per ton extra. *Per 100 lb. (c) Per ton f.o.b. quarry in carloads; 7.00 per ton L.C.L. (d) L.C.L., 9.50–15.00 ton in 100-lb. bags.

Soda Feldspar

De Kalb Jct., N. Y.—Color, white; pulverized (bags extra, burlap 2.00 per ton, paper 1.20 per ton); 99% thru 140 mesh, 16.00; 99% thru 200 mesh, per ton	18.00

Potash Feldspar

Auburn and Topsham, Me.—Color white, 98% thru 140 mesh (bulk)	19.00
Keystone, S. D.—Color, white; analysis, K_2O, 12.30%; Na_2O, 2.28%; SiO_2, 64%; Fe_2O_3, .05%; Al_2O_3, 19.50%, pulverized, 100% thru 140 mesh, in bags, 16.00; bulk	15.00
Coatesville, Penn.—Color, white; analysis, K_2O, 12.30%; Na_2O, 2.86%; SiO_2, 66.05%; Fe_2O_3, .08%; Al_2O_3, 18.89%; crude, per ton	8.00
Erwin, Tenn.—White; analysis, K_2O, 10%; Na_2O, 2.75%; SiO_2, 68.25%; Fe_2O_3, .10%; Al_2O_3, 18.25%, pulverized 98% thru 200 mesh, in bags, 17.20; bulk	16.00
Crude, in bags, 8.50; bulk	7.50
Rumney and Cardigan, N. H. — Color, white; analysis, K_2O, 9-12%! Na_2O, trace; SiO_2, 64-67%; Al_2O_3, 17-18%, crude, bulk	7.00– 7.50
Rumney Depot, N. H.—Color, white; analysis, K_2O, 8-13%; Na_2O, 1-1½%; SiO_2, 62-68%; Al_2O_3, 17-18%, crude, bulk	7.00– 7.50
Spruce Pine, N. C.—Color, white; analysis, K_2O, 10%; Na_2O, 3%; SiO_2, 68%; Fe_2O_3, 0.10%; Al_2O_3, 18%; 99½% thru 200 mesh; pulverized, bulk (bags, 15c extra)	18.00

Cement Drain Tile

Graettinger, Iowa. — Drain tile, per foot: 5-in., .04½; 6-in., .05½; 8-in., .09; 10-in., .12½; 12-in., .17½; 15-in., .35; 18-in., .50; 20-in., .60; 24-in., 1.00; 30-in. 1.35; 36-in. 2.00

Grand Rapids, Mich.—Drain tile, per 1000 ft.

4-in.	36.00
5-in.	48.00
6-in.	66.00
8-in.	100.00
10-in.	150.00
12-in.	210.00

Longview, Wash.—Drain tile, per 100 ft.

3-in.	5.00
4-in.	6.00
6-in.	10.00
8-in.	15.00

Tacoma, Wash.—Drain tile, per 100 ft.

3-in.	4.00
4-in.	5.00
6-in.	7.50
8-in.	12.00

Chicken Grits

Centerville, Iowa	9.25
Cypress, Ill.—(Agstone)	1.15
Belfast, Me.—(Agstone), per ton, in carloads	10.00
Chico. Tex.—Hen size and Baby Chick, packed in 100-lb. sacks, per 100-lb. sack	1.50
Coatesville, Penn.—(Feldspar), per ton, in bags of 100 lb. each	8.00
Cranberry Creek, N. Y.—Per ton, in carload lots, in bags, 9.00; bulk, 7.50. Less than carload lots, in bags	12.00
Davenport, Iowa — High calcium carbonate limestone, in bags L.C.L., per ton	6.00
El Paso, Texas—(Limestone) per 100-lb. sack	.75
Los Angeles, Calif.—Per ton, including sacks: Gypsum	7.50 –9.50
Middlebury, Vt.—Per ton (a)	10.00
Randville, Mich.—(Marble), bulk	6.00
Seattle, Wash.—(Gypsum), bulk, ton	10.00
Warren, N. H.	8.50– 9.50
Waukesha, Wis.—(Limestone), per ton	7.00
West Stockbridge, Mass.	¶17.50–‖19.00
Wisconsin Points—(Limestone), per ton	15.00

(a) F.o.b. Middlebury, Vt. ¶C.L. ‖L.C.L.

Sand-Lime Brick

Prices given per 1000 brick f.o.b. plant or nearest shipping point, unless otherwise noted.

Barton Wis.	10.50
Dayton, Ohio	12.50–13.50
Detroit, Mich. (d)	13.00..16.00*
Farmington, Conn.	16.00
Grand Rapids, Mich.*	14.50
Iona, N. J.	12.00
Jackson, Mich.	13.00
Madison, Wis.	12.50a
Milwaukee, Wis.	13.00*
Minneapolis, Minn.	9.00*
Mishawaka, Ind.	11.00
New Brighton, Minn.	8.00
Pontiac, Mich. (e)	15.50
Portage, Wis.	15.00
Rochester, N. Y.	19.75
Saginaw, Mich.	13.50
San Antonio, Texas	12.00
Sebewaing, Mich.	12.50
South River, N. J.	11.00
South St. Paul, Minn.	9.00
Syracuse, N. Y.	18.00–20.00
Toronto, Canada	12.00–b13.00*
Winnipeg, Canada	15.00

*Delivered on job. (a) Less 50c disc. per M 10th of month. (b) 5% disc., 10 days. (c) Delivered in city. (d) Also 12.00. (e) Truck delivery.

Concrete Block

Prices given are net per unit, f.o.b. plant or nearest shipping point.

City or shipping point	Size 8x8x16
Appleton, Minn.	18.00–20.00
Franklin Park, Ill.: 8x8x16. Per 1000	180.00
Chicago, Ill.: 8x 8x16. Each	.21†
8x 8x16. Each	.18b
8x10x16. Each	.25†
8x10x16. Each	.22b
8x12x16. Each	.28†
8x12x16. Each	.25b
Columbus, Ohio: 8x8x16	14.00b–16.00a
Forest Park, Ill.	21.00*
Graettinger, Iowa	.18– .20
Indianapolis. Ind.	.10– .12a
Lexington, Ky.: 8x8x16	a18.00*
8x8x16	b15.00*
Los Angeles, Calif.: 4x8x12	4.50*
4x6x12	3.90*
4x4x12	2.90*

*Price per 100 at plant.
†Rock or panel face.
(a) Face. (b) Plain. (c) Common.

Cement Roofing Tile

Prices are net per square, carload lots, f.o.b. nearest shipping point, unless otherwise stated.

Clyde, Ill.—French tile, 8½x15 in., per sq., 9.50-12.00; Spanish, 8½x15 in., per sq., 10.00-12.00; English Shingle, 7¼x12½ in., per sq., 13.50-15.50; Closed End Shingle, 8x12½ in., per sq.	11.00–13.00
Detroit, Mich.—5x8x12, per M	67.50
Indianapolis, Ind.—9x15-in.	Per sq.
Gray	10.00
Red	11.00
Green	13.00
Lexington, Ky.—8x15, per sq.: Red	15.00
Green	18.00
Longview, Wash.: 4x6x12-in., per 1000	55.00
4x8x12-in., per 1000	65.00

Cement Building Tile

Chicago District (Haydite): 8x 4x16, per 1000	140.00
8x 8x16, per 1000	200.00
8x12x16, per 1000	300.00
Columbus, Ohio: 5x8x12, per 100	6.00
Lexington, Ky.: 5x8x12, per 1000	55.00
4x5x12, per 1000	35.00
Longview, Wash. (Stone Tile): 4x6x12, per 1000	57.50
4x8x12, per 1000	65.00

Concrete Brick

Prices given per 1000 brick, f.o.b. plant or nearest shipping point.

	Common	Face
Camden & Trenton, N. J.	17.00	......
Chicago District "Haydite"	14.00	......
Columbus, Ohio	16.00	17.00
Ensley, Ala. ("Slagtex")	10.00–13.00a	......
Forest Park, Ill.	......	37.00
Longview, Wash.	16.50	23.00– 40.00
Milwaukee, Wis.	13.00–16.00	15.00– 20.00
Omaha, Neb.	18.00	30.00– 40.00
Philadelphia, Penn.	15.50	......
Portland, Ore.	12.00	22.50– 55.00
Prairie du Chien, Wis.	14.00	22.00– 25.00
Rapid City, S. D.	18.00	25.00– 40.00

(a) Delivered on job; 10.00 f.o.b. plant.

Fullers Earth

Prices per ton in carloads, f.o.b. Florida shipping points. Bags extra and returnable for full credit.

16– 30 mesh	20.00
30– 60 mesh	22.00
60–100 mesh	18.00
100 mesh and finer	9.00

Stone-Tile Hollow Brick

Prices are net per thousand f.o.b. plant.

	No. 4	No. 6	No. 8
Albany, N. Y.*†	40.00	60.00	70.00
Asheville, N. C.	35.00	50.00	60.00
Atlanta, Ga.	29.00	42.50	53.00
Brownsville, Tex.	......	53.00	62.50
Brunswick, Me.†	40.00	60.00	80.00
Charlotte, N. C.	35.00	45.00	60.00
De Land, Fla.	30.00	50.00	60.00
Farmingdale, N. Y.	37.50	50.00	60.00
Houston, Tex.	35.00	45.00	60.00
Jackson, Miss.	45.00	55.00	65.00
Klamath Falls, Ore.	65.00	75.00	85.00
Longview, Wash.	......	55.00	64.00
Los Angeles, Calif.	29.00	39.00	45.00
Mattituck, N. Y.	45.00	55.00	65.00
Medford, Ore.	50.00	55.00	70.00
Memphis, Tenn.	50.00	55.00	65.00
Mineola, N. Y.	45.00	50.00	60.00
Nashville, Tenn.	30.00	49.00	57.00
New Orleans, La.	35.00	45.00	60.00
Norfolk, Va.	35.00	50.00	65.00
Passaic, N. J.	35.00	50.00	65.00
Patchogue, N. Y.	......	60.00	70.00
Pawtucket, R. I.	35.00	55.00	75.00
Safford, Ariz.	32.50	48.75	65.00
Salem, Mass.	40.00	60.00	75.00
San Antonio, Tex.	37.00	46.00	60.00
San Diego, Calif.	35.00	44.00	52.50

Prices are for standard sizes—No. 4, size 3¾x4x12 in.; No. 6, size 3¾x6x12 in.; No. 8, size 3¾x8x12 in. *Delivered on job. †10% disc.

Current Prices Cement Pipe

Prices are net per foot f.o.b. cities or nearest shipping point in carload lots unless otherwise noted

Culvert and Sewer	4 in.	6 in.	8-in.	10-in.	12-in.	15 in.	18-in.	20-in.	22-in.	24-in.	27-in.	30-in.	36-in.	42-in.	48-in.	54-in.	60-in.
Grand Rapids, Mich. (b)																	
Sewer	......	.12	.18	.27⅓	.35	.47	.92½	1.11	......	1.66⅓	2.47	2.73⅔	......	......	......	......	......
Culvert	......	......	......	.57	.67	.93	1.20	......	......	1.80	2.10	2.25	3.35	4.00	5.60	6.90	7.85
Indianapolis, Ind. (a)	......	......	......	.75	.85	.90	1.15	......	......	1.60	......	2.50	......	......	......	......	......
Newark, N. J. (d)	......	......	......	......	.90	1.15	1.50	......	......	1.85	2.35	2.76	3.77	4.93	6.21	7.66	9.28
Unreinforced	......	.16	.25	.38	.48½	.65	.90	......	......	1.62	......	......	......	......	......	......	......
Norfolk, Neb. (b)	......	......	......	.90	1.00	1.13	1.42	......	......	2.11	......	2.75	3.58	......	6.14	......	7.78
Tiskilwa, Ill. (rein.)	......	......	......	.75	.85	.95	1.20	1.60	......	2.00	......	2.75	3.40	......	6.50	......	10.00
Tacoma, Wash.	.15	.17	.22½	.30	.40	.55	.70	......	......	......	......	......	......	......	......	......	......
Wahoo, Neb. (c)	......	......	......	......	.85½	......	1.14	......	......	1.81	......	2.47	3.42	4.13	5.63	6.49	7.31

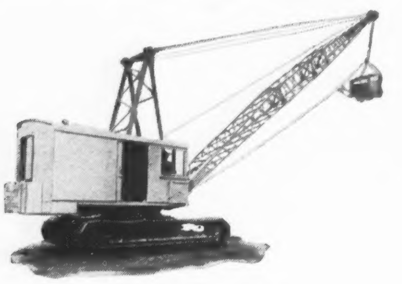
(a) 24-in. lengths. (b) Sewer, 21-in., 1.48; culvert, 21-in., 1.45. †21-in. diam. (c) Reinforced, 15.40 per ton, f.o.b. plant. (d) Reinforced; 21-in., 1.69; unreinforced, 21-in., 1.26; 5% cash discount.

New Machinery and Equipment

New 2-Cu. Yd. Dragline

THE NORTHWEST ENGINEERING CO., Chicago, Ill., has announced a new dragline unit which handles a 2-yd. bucket on a 50-ft. boom at a 40-ft. radius, equipped with crawlers 17 ft. 5 in. long and treads 33 in. wide, giving a large bearing area capable of carrying the machine over soft ground.

The power plant is a Northwest variable speed gasoline motor, accelerator controlled. Clutches are shifted through the "feather-touch" control, all high speed shafts being mounted on ball bearings. The drive from the engine is through helical gears mounted on ball and roller bearings and running in oil, with positive traction even when turning.



New dragline unit

The machine is equipped with a 200-gal. gasoline tank.

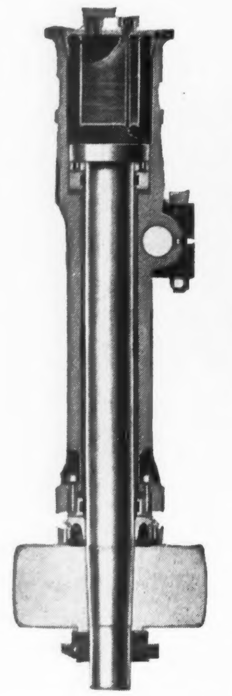
An Oil Lubricator for Raymond Mill Journals

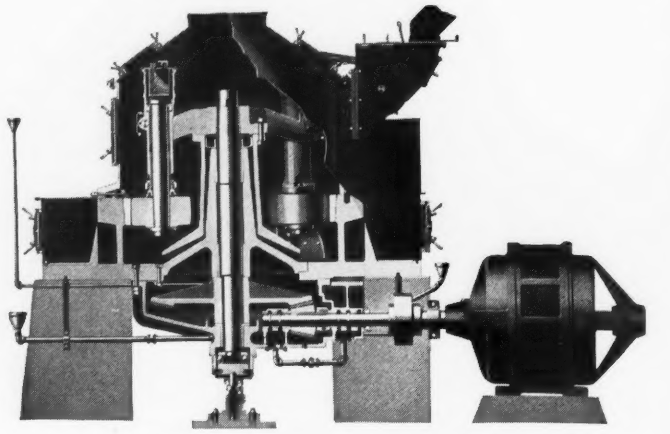
THE TEXACO centrifugal lubricator as here illustrated was developed and perfected by engineers of the Texas Co., New York City. It was designed to give economical lubrication with oil to certain types of equipment, and is adapted to fill the space formerly used as a grease reservoir. It is manufactured and distributed by the Texas Co.

This oil lubricator is easily installed in the upper end of the roll housing, utilizing the space originally designed for a grease reservoir, and the flanges of the lubricator replace the cover or plug at the top of the roll housing.

The pressure necessary to raise the oil to the top of the tube is produced by centrifugal force. The tube is of such a diameter and length that it measures and delivers exactly the amount of oil necessary to lubricate the roll journal and its bearings. There are no moving parts in this lubricator and no hand adjustments are necessary.

The widest variations in operating conditions of these mills are those caused by differences in temperature. When the centrifugal lubricator is in use it is adapted to these varying conditions by merely a change in the grade of oil used. Various grades of oil were developed as a result of the experience of the designing engineers with these devices under different climatic and operating conditions.





Above—Cross-section view of centrifugal oil lubricator as applied to mill. Left—Centrifugal lubricator as applied to mill journal

Exhaustive tests made in several plants indicate that the centrifugal lubricator may be expected to attain the following results, according to the announcement of the Texas Co.:

(1) Lowers lubrication costs: It effects a saving to the operator of from 60% to 90% in cost of lubricant. According to the manufacturers, the lubricator was installed at the Gould Street Station of the Consolidated Gas and Electric light and Power Co., Baltimore, in two 20-ton, 6-roll Raymond mills on a test run of 85,000 tons of coal first using grease at 5c per lb. The grease cost was $1530, but with lubricators installed the cost was but $168, for 85,000 tons coal milled. Further, using grease, it was necessary to shut the mills down every six hours for greasing while the oil lubricator gives 40 hours of operation.

(2) Lowers power costs: Power consumption is reduced from 1 to 3 kw. per mill. A large gypsum products manufacturing company using the new oil lubricators reduced costs 66%. A limestone company pulverizing limestone reduced costs 75% using the new oil lubricator.

(3) Increases operating hours: When grease is used, the period of continuous operation between shut-downs for renewing the lubricant is 4 to 10 hrs. When the centrifugal lubricator is used, the period of continuous operation between shut-downs for renewing lubricant is increased to about 60 hrs.

(4) Reduces each shut-down period: Time required for oiling is only 20 min.

(5) Lowers operating temperatures: It lowers roll journal temperatures during operation of mill 15 to 40 deg.

(6) Lessens mechanical wear: Wear is greatly reduced—no sticking of roll shafts.

(7) Eliminates product contamination: Considerable economy results because there is practically no contamination of the product by the lubricant.

It is said that the economies thus effected in plants equipped with the centrifugal lubricators have in some cases offset the total cost of lubricating the entire plant.

Self-Priming Pump

THE CHAIN BELT CO., Milwaukee, Wis., has added to its line of pumps a new self-priming centrifugal pump which, it is said, takes practically all the air out of the chambers and maintains its priming, no matter whether the depth of the hole is 27 in. or 27 ft., and regardless of the amount of water.

According to the manufacturers, on many

Self-priming centrifugal pump

pumping jobs there are times when very little water is in the hole, and while this may be the case one minute, the next minute water may rush in and fill up the excavation, and therefore the pump used must be ready to take care of the increase of water without any attention. Ordinary pumps, they state, lose their priming when the water barely covers the end of the hose or pipe, and then when the flow increases they have to be primed before they can resume pumping, but the new self-priming centrifugal requires no attention even though the water does go below the end of the hose, for the vacuum is maintained automatically. Just as soon as the water begins to drop the vacuum pump begins to exhaust the air and pick up the prime again.

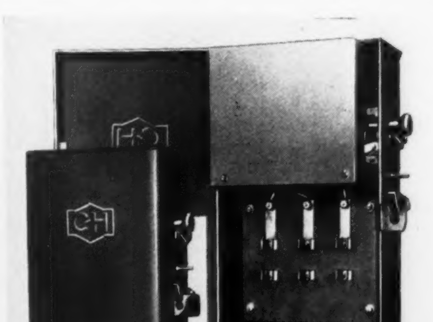
The difficulty caused by air pockets at the hub of the centrifugal vanes interfering and many times destroying the priming has been overcome, it is claimed, in the new pump by making it possible to remove these air pockets before they can be sealed.

Motor Starter with Fusible Disconnect Switch

CUTLER-HAMMER, INC., Milwaukee, Wis., has developed a new alternating current across-the-line automatic starter combined with a fusible disconnect switch in a single steel enclosing case.

This new starter, state the manufacturers, may be used in place of the separate starter and fusible disconnect switch, simplifying installation, requiring less space and presenting a neater appearance.

A feature of this unit is a wiring channel between the starter panel and the back of the enclosing case which allows running the connecting wires behind the panel, where they cannot interfere with the operation of the starter. Ample room is provided to bring all of the connecting wires in at either the top or the bottom of the case, according to installation requirements. All parts are mounted on a back plate which is easily removed for pulling and placing of line and motor wiring.



Automatic motor starter combined with fusible disconnect switch

The disconnect switch is manually operated from the outside of the enclosing case. A cover interlock prevents opening the cover when the switch is closed, and prevents closing the switch if the cover is open, unless the interlock is manually released. An electrical interlock insures that the magnetic contactor of the starter is always open when the disconnect switch is open. The fuse clips are mounted on a slate base, just below the disconnect switch.

A New Metal for Chains

A NEW LINE of cast chains, said to have remarkable strength and durability, has been placed on the market by Link-Belt Co., Indianapolis, Ind., under the trade name of "Promal." Experimentation with cast-chain metals was

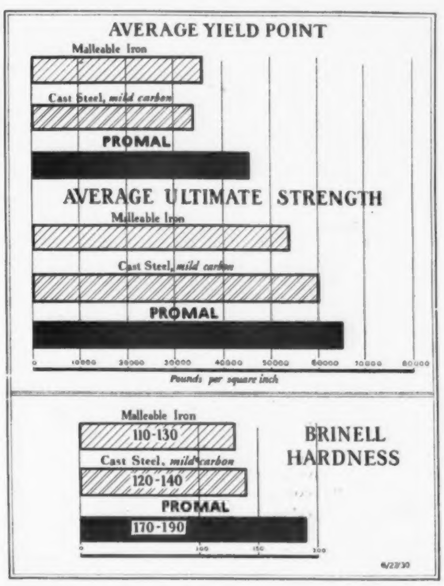


Chart of manufacturer to show average yield point, ultimate strength and Brinell hardness of new metal

started by the company about four years ago, and led to the discovery of a new method of processing malleable iron, which it is claimed so altered its physical characteristics as to make it a distinctly new metal.

The manufacturers state that compared with malleable iron Promal has an average yield point of 45,000 lb. per sq. in., as against 36,000 lb.; an average ultimate strength of 65,000 lb. as against 54,000 lb., an average elongation of 14% as against 18%, and a Brinell hardness of 170-190 as against 110-130, and a similar showing as compared with mild cast steel, annealed. It is asserted that the new metal is particularly suitable for sprocket chain material, having great toughness to resist extreme tension without permanent stretch, high strength in proportion to weight and size, and hardness that affords great resistance to abrasive wear.

Extensive field tests over a period of three years were made of the wearing

Typical chain link made of new metal which is said to have great resistance to abrasive wear

qualities of chains made of the new metal. For these tests many chains were tried out in various industries and a check was kept on the performance of the chains while subjected to every-day usage. For example, in one Eastern cement mill, claim the manufacturers, a Promal chain running night and day in an atmosphere of cement dust, has already lasted more than twice as long as the malleable chain used before and shows no evidence of serious wear.

The Promal chains are particularly recommended for four general classes of service: (1) chain drives, elevators and conveyors operating under gritty or abrasive conditions; (2) chain drives where great strength is required; (3) drag, scraper and flight conveyors where the chain drags and is subject to abrasion, and (4) heavy duty drives of comparative high speed, short centers and large sprocket ratios.

New Welding Rod

THE BONNEY-FLOYD CO., Columbus, Ohio, is marketing a new welding rod under the trade name of "Hardkote." The rod is said to have extreme hardness, toughness and resistance to abrasion that is several times that of manganese steel. The welding rod can be applied with gas or electric welding equipment.

Write pros
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News of All the Industry

Incorporations

Louisiana Shell and Gravel Co., Inc., Dunbar, La.

Dalrymple Sand and Gravel Co., Nixon, N. J., $50,000. Klemmer Kalteissen, New Brunswick, N. J.

Virginia Limestone Products, Inc., Staunton, Va., $125,000. R. L. James, president.

Jamaica Sand and Gravel Concrete Corp., Jamaica, N. Y., $10,000.

American Builders Supply Co., Louisville, Ky., increased capital stock from $50,000 to $150,000.

The Concrete Gravel Co., Hattiesburg, Miss., $24,000.

Ball Bros., Ltd., Kitchener, Ont., $200,000. To produce building materials.

The Chester Valley Lime and Products Co., Wilmington, Del., $400,000 preferred and 6000 shares common.

American "Cement Lumber" Corp., $100,000 preferred and 6000 shares common. C. McMillan, 165 Broadway, New York.

West Nyack Trap Rock Co., West Nyack, N. Y., 200 shares common. J. S. Seidman, 41 Park Row, Manhattan, N. Y.

Brooklyn Sand and Gravel Co., Independence Village, Ohio, 250 shares no par value. O'Brien and Holland, 1804 Engineers Bldg., Cleveland.

C. H. Fuller Lime Distributing Corp., Manhattan, New York City, $50,000. B. C. Fuller, 17 John St., New York City.

Three Man Gravel Plant Co., Inc., New Orleans, La., $16,000. A. D. Alderson, Bienville Hotel, New Orleans.

North State Material Co., Asheville, N. C., 1000 shares of no par value stock. E. Raynor Wilson, Myrtle A. Wilson and Thomas J. McNeil of Asheville.

Atlantic Granite Co., Columbia, S. C., $6000. To own and operate quarries. George D. Lott, president and treasurer; R. S. Campbell, vice-president, and T. I. Weston, secretary.

St. Louis Portland Cement Co., 606-18 First National Bank Bldg., East St. Louis, Ill., 1000 shares common of no par value. C. D. Nichols, Frank Krill and R. H. Wiechert.

Roman and Co., Inc., 310 S. Michigan Ave., Chicago, $50,000. To deal in products of stone, cement, tile, etc. John Roman, Charles A. Burke and Thomas Edward Carey.

Practical Cement Products Co., Inc., Indianapolis, Ind., 600 shares, having a par value of $50 each. Paul C. Burkholder, Eugene E. Sims and Ruth Van Meter.

Quarries

Indiana Limestone Co., Bedford, Ind., announces that profits for the six months ended May 31, 1930, were $1,025,925, comparing with $719,758 in the same period of the preceding fiscal year.

Georgia Granite Co., Elberton, Ga., has let contract to the Converse Bridge and Steel Co., Chattanooga, Tenn., for construction of a stone shed, to be one story, 340x55 ft., and to cost approximately $25,000.

Bonaparte, Iowa. The Douds Quarry at Bonaparte is being enlarged and with the completion of the installation of new machinery and equipment its present output of six carloads of crushed stone daily will be doubled.

Fostoria, Ohio. A large abandoned quarry at Fostoria is to be converted into a swimming pool and used as an auxiliary water supply for the filtration plant of the city, if plans now being negotiated by the finance committee of the Fostoria city council are consummated.

Central Kansas Quarries, east of Ottawa, Kan., is installing new equipment to more than double its present capacity. According to Manager J. M. Kirk, the new equipment, including a large crusher, will make it possible to produce from 25 to 30 cars of crushed rock a day.

Le Roy Lime and Crushed Stone Corp., Le Roy, N. Y. A four-story building to be used by the Colprovia Pavement Co. is in process of erection at the company's plant east of Le Roy. The pavement company will be connected with the stone corporation, manufacturing asphalt and stone products for repaving roads.

Mathieson Alkali Works' Porterfield quarry near Saltville, Va., has just completed one of the best safety records ever made in a limestone quarry. On June 6 the employes of this quarry passed the 365th day without a lost-time accident. During this period the men worked more than 300.000 hours. A year ago the quarry raised a safety flag and beneath the flagpole erected a sign, "Keep Our Safety Flag Flying," with the result that a much greater interest was taken by the men in safety.

Grafton, Ill. Eugene Keller of Louisiana, Mo., has been in this vicinity making arrangements to reopen one of the old Grafton quarries. The principal product of the quarry will be agricultural limestone, and a large rock crusher will be installed for the purpose. Building stone will also be produced. The last attempt at reviving the quarry industry in this vicinity, it is said, was made a year ago at the Armstrong quarry. This, however, was discontinued because of the lack of demand for building stone.

Markgraf and Lamb, Joliet, Ill., has leased 80 acres of land on the Robert Murray farm, northeast of Pontiac, Ill., and preparations for a large stone quarry and crushing plant on the site are now under way. Tests made in the past several weeks indicate an unusually good supply of limestone. In addition to the rock crushing plant, a machine shop and large storage bins are to be erected, and the company proposes to build a switch from the Wabash railroad main lines to its plant.

Sand and Gravel

Northern Gravel Co., West Bend, Wis., celebrated the opening of its new machine shop with a dance for the employes of the company, their families and residents of West Bend.

Warner Co., Philadelphia, Penn., has been awarded a contract to furnish material for foundations for the Pennsylvania railroad's new shop buildings and roundhouse at 46th St. and Parkside Ave., Philadelphia.

F. G. Boyden, Sheffield, Ill., has sold his gravel plant at Wyanet, Ill., to P. Rutherford. Mr. Rutherford has already taken possession and has resigned as manager of the Allied Telephone Co. at Sheffield in order to devote all his time to operating the plant.

Gilley Bros., Ltd., New Westminster, B. C., is rushing work on its new gravel pit at Mary Hill, near the mouth of the Pitt river, and it is expected the pit will soon be on full production. Piling is being driven for a scow-loading wharf and storage bins are being constructed on the site.

Sun River (Cascade County), Mont. A new gravel pit, located on state land about a mile south of the Sun River bridge, has just been opened and will be operated by the county. The gravel is to be used in gravelling the connecting road between the Gore hill highway and the Sun River road, and for other road work in the vicinity.

Gypsum

Gypsum, Lime and Alabastine, Ltd., Paris, Ont., Canada, reports that sales for the month of May show an increase of 7% over the same month last year and that sales for the five months ended May 31 this year are 12% over those for the same period in 1929.

Cement

Ideal Cement Co., Denver, Colo., reports that business for the first six months of 1930 is 295,000 bbl. ahead of the figures for the first six months of 1929.

Ash Grove Lime and Portland Cement Co. has moved its general offices to larger quarters on the 11th floor of the Fairfax Bldg., 101 West 11th St., Kansas City, Mo.

Three Forks Portland Cement Co.'s plant at Hanover, Mont., which is now operating at about one-third capacity, according to J. C. Capper, superintendent of the plant, will be operated at full capacity just as soon as an adequate coal supply can be obtained from the mines at Roundup.

Northwestern States Portland Cement Co., Mason City, Iowa, at its semi-annual directors' meeting held recently discussed plans for the reorganization of the company as an Iowa corporation. At the present time it is incorporated under the laws of West Virginia. Plans were also discussed by the directors for continuing operations at the plant in order to furnish employment throughout the year.

British Columbia Cement Co., Ltd., Victoria, B. C., has received an order for 200 carloads of cement, comprising 40,000 bbl., to be used in the concrete work at the Ruskin dam. This cement order is being delivered at the rate of five cars or 1000 bbl. a day, and represents an expenditure of $120,000. It is only about a third of the total amount of cement required for the completed dam, which is expected to reach 130,000 bbl.

Cement Products

Becker Bros., Vermilion, Ohio, are manufacturing a new product known as "Stoneage," which is a form of concrete with a smooth finish resembling marble. It is claimed the new product makes a beautiful and lasting interior finish.

Arnold Granite Block Co., East Peoria, Ill., a new cement products and sand and gravel enterprise headed by Charles Arnold, former mayor of East Peoria, has established a plant near Route 8, just beyond East Peoria city limits. Granite face and plain cement blocks will be produced and a plant has already been installed for screening sand and gravel for contractors.

Miscellaneous Rock Products

Superior Earth Co., Ocala, Fla., is building an addition to its fuller's earth plant.

Personals

D. J. Kelly, manager of operations of the Greer Limestone Co., Greer, W. Va., has also been made manager of sales for the company.

James A. Barr, chief engineer of the International Agricultural Corp., Mt. Pleasant, Tenn., returned to Tennessee early in June after a trip abroad.

L. A. Beeghley, president of the Standard Slag Co. and the Bessemer Cement Corp., Youngstown, Ohio, is at the north side unit of the Youngstown hospital, following an operation for appendicitis.

T. A. Burns has joined the sales organization of Harnischfeger Corp. and will work directly out of the general sales department in the home office at Milwaukee, Wis.

L. C. Newlands, vice-president and general manager of the Oregon Portland Cement Co., Portland, Ore., discussed the history of cement making before the Portland Rotary Club at its recent luncheon.

J. E. Baker, president of the Laura Gravel and Stone Co., Phillipsburg, Ohio, and the Phillipsburg State Bank, has filed a petition to run as state representative on the Republican ticket at the primary election in August.

R. G. Sutherland, of the Trinity Portland Cement Co., Houston, Tex., was the principal speaker at the regular meeting of the Houston Industrial Safety Association on June 16. Mr. Sutherland recently returned from New York, where the Houston plant was awarded a trophy for accident prevention.

Hiram Norcross, vice-president and general manager of the Missouri Portland Cement Co., St. Louis, Mo., recently visited Tulsa to make arrangements for the test drillings to determine a location for the cement plant and quarry which the company plans to establish here, as reported in the June 21 issue of ROCK PRODUCTS.

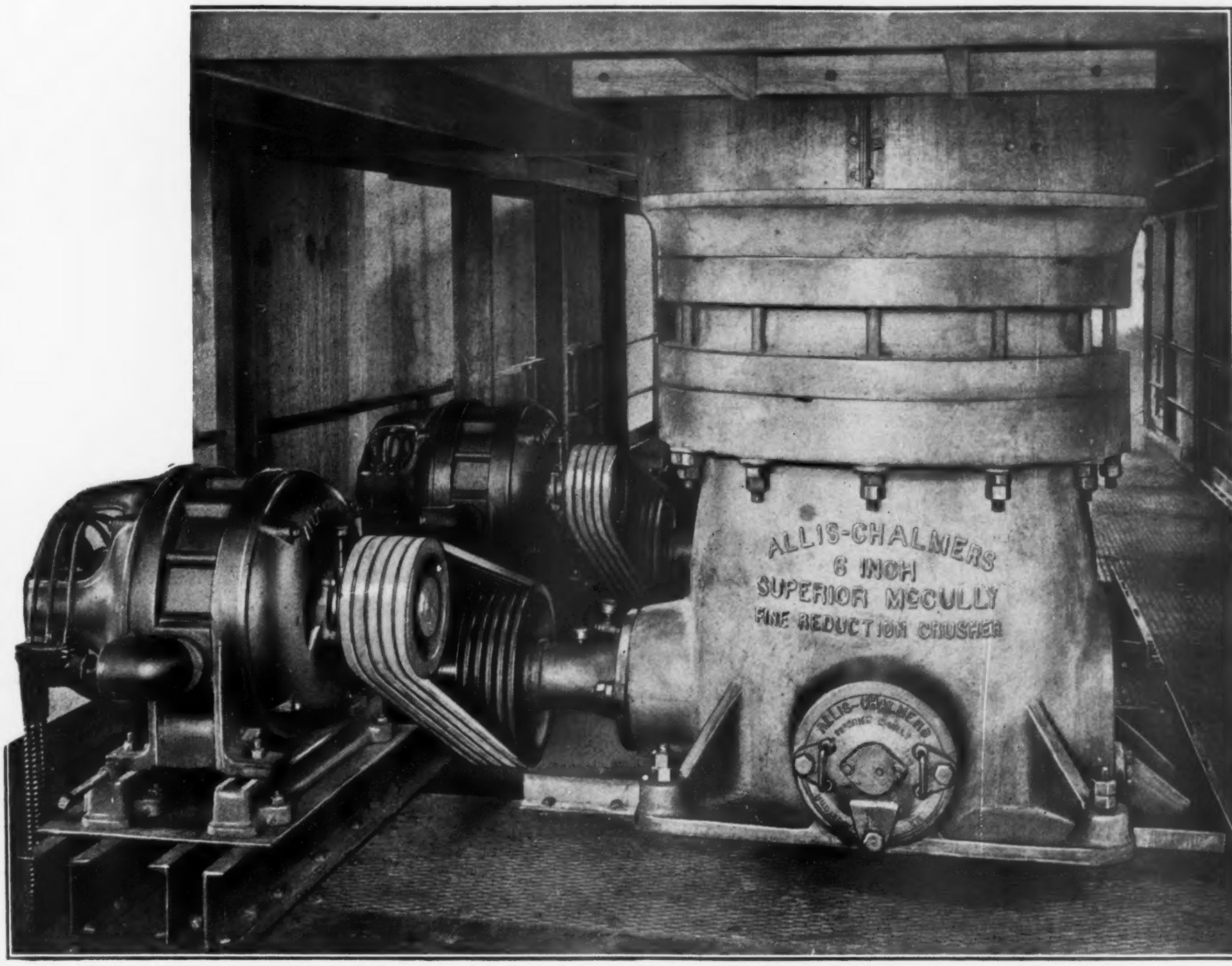
Scott Turner, director of the United States Bureau of Mines, on June 23 received the honorary degree of Doctor of Engineering from his alma mater, the University of Michigan. A few days before he received the honorary degree of Doctor of Science from the Colorado School of Mines.

R. S. Hall, formerly president of the Bourne Fuller Co., one of the components of the Republic Steel Corp. merger, has been named vice-president in charge of operations and sales of the Upson Nut division of the corporation. This division will be devoted to the production and sales of bolts and nuts from the Cleveland and Muncie plants of the corporation.

Cummings C. Chesney, vice-president and chair-

Change pros. card

See Classification



Two 6-inch Fine Reduction Crushers installed in the crushing plant of the Arrow Sand & Gravel Company, Columbus, Ohio. These crushers are driven through Allis-Chalmers motors and Texrope Drives.

Producing a Uniform Product at Low Cost

THE Superior McCully Fine Reduction Crusher fits in well with modern crushing conditions which demand a uniform product at low cost. This reduction crusher has high capacity, dependability and strength. It is built and serviced by Allis-Chalmers, a pioneer in the development of the gyratory crusher and today one of the world's leading manufacturers of crushing and grinding machinery.

This crusher is simple in construction, with all parts readily accessible. It has a short, rigid, hollow bored, forged steel main shaft; large cast steel eccentric; cut steel gears; positive, patented oiling system; and reversible top shell with vertical concaves. These features insure long life and freedom from shut-downs for repairs. Superior McCully Fine Reduction Crushers are built in three sizes, with receiving openings of 6, 10 and 18 inches. They are described in Bulletin 1461-A.

ALLIS-CHALMERS MANUFACTURING COMPANY, MILWAUKEE, WIS.

ALLIS-CHALMERS

MILWAUKEE, WIS. U.S.A.

man of the manufacturing committee of the General Electric Co., Schenectady, N. Y., has been relieved of his duties at his own request on July 1, and is succeeded as chairman by Vice-President **William R. Burrows**. Mr. Chesney is a pioneer in the electrical industry and has seen more than 42 years of continuous service with the General Electric and Stanley companies. Since 1927, when Messrs. Chesney and Burrows were elected vice-presidents, they have been serving together as manufacturing officials of the company.

H. V. Chase has been appointed assistant director of operations of the explosives department of the Hercules Powder Co., Wilmington, Del. For the past two years Mr. Chase has been superintendent of the Kenvil, N. J., explosives plant, and previous to this he was superintendent of the Bessemer, Ala., and Bacchus, Utah, plants of the company. In his new position he will assist William C. Hunt in directing the operations of the 11 Hercules explosives plants in various parts of the country. Succeeding Mr. Chase at Kenvil, W. S. Brimijoin has been appointed superintendent of the Kenvil plant. Formerly superintendent of the Joplin, Mo., and Bessemer, Ala., plants, Mr. Brimijoin has been assistant superintendent at Kenvil since 1928.

Gordon F. Daggett has established offices as a consulting engineer, specializing in sand, gravel and crushed stone plant design, construction and equipment, at 2404 Clybourn St., Milwaukee, Wis. Mr. Daggett is a graduate civil engineer from the University of Wisconsin and has had several years' experience in this line of design and construction. For a number of years he was materials engineer for the Wisconsin Highway Commission, following which for three years he was executive secretary and consulting engineer to the commercial sand, gravel and crushed stone producers in Wisconsin. Early in the year 1929 he resigned from the Wisconsin Mineral Aggregate Association and became affiliated with the Boehck Machine Co., Inc., of Milwaukee, as a member of the firm and its chief engineer, which connection he still retains in addition to his consulting practice.

Manufacturers

General Refractories Co., Philadelphia, Penn., has moved its Detroit sales office to 2328 Union Trust Bldg., Detroit, Mich.

G. H. Williams Co., Erie, Penn., announces the appointment of Kratz & McClelland of San Francisco, Calif., as it agents in northern California.

Caterpillar Tractor Co., San Leandro, Calif., has let contract for the construction of a new building to cost about $200,000 at its Minneapolis plant. The company is also constructing a warehouse and another building at its Peoria, Ill., plant.

Wagner Electric Corp., St. Louis, Mo., announces the appointment of H. W. Petty as branch sales manager for the Pittsburgh territory with headquarters in Pittsburgh. Since 1925 he has been serving the company in a sales capacity in the Detroit territory.

Harnischfeger Corp. of Canada, Ltd., Canadian distributor for Harnischfeger Corp., recently established with headquarters at Ottawa, Can., announces the opening of an office at 504 Dominion Square Bldg., Montreal, Que., Can. L. P. Deephouse is district manager in charge.

Hercules Motors Corp., Canton, Ohio, reports that Hercules engines are conquering new fields in the Orient. The Kato Works at Tokio, Japan is building a line of gasoline locomotives and equipping several models with heavy-duty Hercules engines. K. Hattori and Co., Ltd., of Tokio, are distributors for Hercules products in Japan.

The Roessler and Hasslacher Chemical Co., New York City, held its annual sales and service convention at Niagara Falls, on June 9-11, attended by executives from the company's manufacturing plants and New York offices, district sales managers, sales and service men from various branches in the United States, Canada and Mexico.

Hercules Motors Corp., Canton, Ohio, has appointed the following new distributors in various sections of the United States, who will handle Hercules engines, power units and parts: F. C. Richmond Co., Salt Lake City, Utah, as exclusive distributor for the Mountain States; Worthington Machinery Corp. of Oklahoma, Tulsa, Okla., for Oklahoma and adjacent territory, and the Alamo Iron Works of San Antonio, Texas, who will sell Hercules engines and parts in a section of Texas.

E. I. du Pont de Nemours and Co.'s employes and executives joined in an observance of the 50th anniversary of the Repauno plant at Gibbstown, N. J., on June 19. The several hundred employes of the plant held a picnic at which addresses were made by Lammot du Pont, president of the company; J. W. McCoy, general manager of the high explosives department, and others. The Repauno plant is said to be the largest dynamite plant in the world.

Bullard-Davis, Inc. (Del.), subsidiary of Davis Emergency Equipment Co., Inc., New York City, announces that L. S. Johnston has been added to the Boston, Mass., territory as sales representative. The company also announces that its Houston, Texas, office is still at 720 Leeland Ave., with H. C. Weigley in charge of this office, assisted by J. E. Blakemore, and that a wholly-owned subsidiary company, Davis Emergency Equipment Co., Ltd., has been formed, located at 1268 Mission St., San Francisco, Calif.

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., through its subsidiary, Westinghouse Electric International Co., has joined with a group of Spanish financial and industrial leaders in the formation of a new company, known of Constructora Nacional Maquinaria Electrica. The new company will manufacture electric generators, motors, transformers and other electrical apparatus in Spain. Arrangements have been made whereby the new company will collaborate with Westinghouse Electric International Co. and Le Material Electrique S-W., the French company formed recently by Schneider-Crousot and Westinghouse interests. These arrangements secure for the Spanish company, engineering, manufacturing and research information, the granting of exclusive patent rights for Spain, and the technical guidance of the Westinghouse company.

Trade Literature

NOTICE—Any publication mentioned under this heading will be sent free unless otherwise noted, to readers, on request to the firm issuing the publication. When writing for any of the items kindly mention ROCK PRODUCTS.

Tractors. Issue **No. 50** of the Caterpillar Magazine, containing illustrated accounts of typical Caterpillar installations. CATERPILLAR TRACTOR CO., San Leandro, Calif.

Variable Speed Transmission. Bulletin covering Reeves variable speed transmission, with illustration of its application to various industries. REEVES PULLEY CO., Columbus, Ind.

Paper Bags. New bulletin on Bates dust- and moisture-proof Multi-Wall paper bags, for use in packing cement, plaster, lime and other products. BATES VALVE BAG CORP., Los Angeles, Calif.

Mills, Dryers, Weight Feeders and Sand Filters. New bulletin on Hardinge conical mills, Ruggles-Coles dryers, thickeners, clarifiers, constant weight feeders and sand filters. HARDINGE CO., York, Penn.

Gyratory Crushers. Folder on Traylor Bulldog finishing gyratory crushers, built in five sizes, with a product range of from 6 tons per hour to ½-in. ring size to 225 tons per hour to 2-in. ring. TRAYLOR ENGINEERING AND MANUFACTURING CO., Allentown, Penn.

Fire Brick. Folder on the proper selection of fire brick for the job, and giving a detailed description of the laboratory-tested fire brick made by LACLEDE-CHRISTY CLAY PRODUCTS CO., St. Louis, Mo.

Refractory Products. "Corundite Refractory Products" is the title of a new catalog containing information in connection with the use of standardized clay fire brick and super refractories. CORUNDITE REFRACTORIES, INC., Massillon, Ohio.

Safety Equipment. The May issue of "Safety Service Digest," a monthly bulletin of information on safety devices, including first aid kits and supplies, gas protection equipment, linemen's safety equipment, safety clothing, etc. BULLARD-DAVIS, INC., New York City.

Material Handling Conveyors. New catalog, **No. 202**, giving a complete description of the Rex line of equipment for the handling of bulk materials, including elevators and conveyors of every type, as well as a full line of buckets, boots, chains, attachments and other auxiliary equipment. CHAIN BELT CO., Milwaukee, Wis.

Air Filters. Reprint of an article by Everett P. Partridge from Industrial and Engineering Chemistry, entitled "Improved System for Spray Drying and Recovery of Product," covering a new system of spray drying recently installed at a Michigan plant. THE DUST RECOVERING AND CONVEYING CO., Cleveland, Ohio.

High-Early-Strength Portland Cement. The advantages of "Incor" Brand Perfected High-Early-Strength Portland Cement, from the standpoint of time-saving, workability, plasticity, density and economy, are discussed in a new circular issued by the INTERNATIONAL CEMENT CORP., New York City.

Conveyors. Catalog **No. 202** on bulk material-handling conveyors, giving complete engineering data and illustrations on bucket elevators of all types, super-capacity elevators, bin gates, track hoppers and feeders, steel apron and pan conveyors, weigh larries and screw conveyors. CHAIN BELT CO., Milwaukee, Wis.

Locomotives. New broadside showing various types and sizes of Whitcomb locomotives, including the gasoline 4-wheel locomotive from 3 to 30 tons; the trolley locomotive, from 4 to 20 tons; distillate 6-wheel from 16 to 60 tons; oil-electric, 8-wheel, from 40 to 100 tons; Diesel 4-wheel from 6 to 30 tons, and the storage battery from 2 to 14 tons. GEO. D. WHITCOMB CO., Rochelle, Ill.

Safety Equipment. Catalog **No. 30**, entitled "Everything in Safety," containing 144 pages picturing and describing a complete assortment of safety material and equipment for all industries, with working information and data of interest and value to all interested in safety work. E. D. BULLARD CO., San Francisco, Calif.

Rotary Kilns and Coolers. Bulletin describing and illustrating three types of rotary kilns, namely, parallel kilns, kilns with enlarged burning zones, and kilns with cooler attachments. Bulletin gives details of mechanical construction, instruction as to rotary kiln firing, feeding and general operation. EDGAR ALLEN AND CO., LTD., Sheffield, England.

Water Supply Systems. Complete description and details of a new water works system, comprising processes designed to get rid of color, taste, hardness and deposits in services and meters, and to control the bacterial content, including deaeration, chemical treatment, mechanical agitation for mixing, sedimentation, carbonation, filtration and chlorination, are given in an article by F. J. Keis, reprinted from Engineering News-Record, which is being distributed by the DE LAVAL STEAM TURBINE CO., Trenton, N. J.

Evaporators. Bulletin **361** discussing fully the history, functions, applications and advantages of evaporators for distilling boiler-feed makeup water and the different types of evaporator systems that have been found most advantageous for various operating conditions. Completely illustrated with photographs of installations and diagrams showing how evaporators may be associated with other plant apparatus for efficient operation. THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York City.

Shovels. Bulletin describing and illustrating the five big Marion quarries, namely, Type 460, 1½-yd. shovel (electric or steam) suited for quarries of limited output; Type 480, 2-yd. machine (electric or steam), designed especially for quarries where extra high speeds are required; Type 5120, 3-yd. machine (electric), of close-coupled design for volume production wherever extended ranges are required; Type 490, 2¼-yd. (electric), a heavy-duty machine built for quarries where extreme ruggedness and relatively high speeds, with high bail pull, are needed; Type 4160, 4-yd. (electric), an exceptionally rugged, close-coupled revolving shovel for use where heavy duty and top production are required. THE MARION STEAM SHOVEL CO., Marion, Ohio.

Demolition Tools and Sheeting Driver. Bulletin **865**, describing the BQ-46 demolition tool adaptable for such uses as tearing out concrete and brick foundations and walls, cutting asphalt pavement, trenching, and removing slag from ladles and slag pockets, and the CP-116 demolition tool, recommended where a heavy and powerful tool is required and weight is not so much of a factor, and also where the air pressure is apt to be below 80 lb., as in connection with portable compressor operation. Also describes the CP-116 sheeting driver, essentially the same as the CP-116 demolition tool, with a special front end, designed primarily to take wooden sheeting—for use in trench work and excavations, in formations that sheeting will penetrate without breaking, such as clay, sand, gravel, etc. CHICAGO PNEUMATIC TOOL CO., New York City, N. Y.

To Celebrate Centennial of Invention of Platform Scale

TO COMMEMORATE the invention of the modern platform scale by Thaddeus Fairbanks in 1830, Fairbanks, Morse and Co., Chicago, Ill., held centenary exercises and a pageant at Saint Johnsbury, Vt., on July 4, 5, and 6.

The principal features of the program comprised a historical pageant depicting the progress during the last century in the evolution of the modern weighing machine, and its influence upon human welfare and world commerce. There was also an exhibition of original patent models of scales invented by Fairbanks, which have been borrowed for the occasion from the patent office.

Former President and Mrs. Calvin Coolidge were to be guests of honor at the celebration which had the sponsorship of the Vermont Historical Society, the New England Advisory Council.